J. Nelson Spaeth.

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ECONOMIC ASPECTS OF OUR TIMBER SUPPLY[1]

BY W. B. GREELEY

Chief, U. S. Forest Service

On Chesapeake Bay, just below the city of Baltimore, an enormous yard has been established for storing and distributing lumber manufactured on Puget Sound. As you watch the unloading of a steamer at this yard, jump in your mind across the continent to the sawmill where it received its cargo, and follow its 6,000-mile course through the Panama Canal, you readily grasp the leading factor in the lumber business of the United States at the present time and the controlling factor in its future provision of timber, namely, transportation. These lumber ships docking in Chesapeake Bay are not laden with cabinet woods or with timber of special and distinctive value. Their cargoes contain a large proportion of framing, siding, flooring, of the grades of lumber used every day in the construction of dwellings and for the more common industrial purposes. At Chesapeake Bay, you may see this lumber transferred to freight cars for reshipment to points all through the Middle Atlantic States. Some of it is shipped inland as far as Cincinnati and Pittsburgh.

The factor of transportation dominates our forest situation. At the time of the Civil War, lumber manufacture was a local, or at least a nearby, industry in every State east of the Mississippi River. One hundred or two hundred miles marked the limit of ordinary lumber shipments from the sawmill to the market. A dollar or two a thousand feet covered the freight on the lumber of every-day use. And then with the tremendous industrial development of the 70's and 80's, came

[1] Read before the general session of the New England Forestry Conference, Society of American Foresters, and Section K (Social and Economic Sciences) of the American Association for the Advancement of Science, December 28, 1922, Boston, Mass.

the enormous sawmill, the concentration of lumber manufacture in particular regions, and its gradual movement to the West and South. With each successive outward "trek" of the sawmill, transportation has become a more important factor in the lumber business. About every twenty years, the center of lumber production has shifted to some new region still farther away from the largest centers of lumber consumption; and the freight paid on the average carload of lumber has reached a higher level. The cost of lumber transportation, either as a yearly total or on the average thousand feet, is the true barometer of the depletion of our virgin forests. Furthermore, the cost of transportation from the manufacturing region which furnishes the bulk of the lumber supply for any given market, at any given time, has to a very important degree controlled the general level of lumber prices.

Today the big sawmilling industry of the country is dropping behind the Rocky Mountains. Washington and Oregon have become the two leading lumber producing States. It is doubtful if, within another decade, the pineries of the South will be an important factor in supplying the markets of the twenty-eight States which have become lumber importers. Eastbound lumber shipments from the West Coast, by rail and by water, are increasing rapidly. Ten or fifteen years hence that region, which contains two-thirds of the standing timber remaining in the United States, will apparently be our only large source of softwood lumber for the general trade. Already the cost of transportation from the West Coast is becoming a factor in the retail lumber markets of the eastern States.

The lumber movement in 1920 exceeded two million carloads, with an average haul of 485 miles. Lumber freights and charters reached a total of $275,000,000, which represents between $8 and $9 per thousand board feet on the average shipment. A large part of the lumber consumers in the United States are paying more for freight today than they paid thirty years ago for the commodity delivered at their doors. Many users of general construction lumber in the central and eastern States pay more for freight than this product is worth at the sawmill where it is manufactured.

It is not difficult to put in concrete terms how the rising cost of transportation has influenced the large eastern and central lumber markets. Take Chicago as an example, the greatest lumber mart in the world. Roughly, two billion feet of lumber enters Chicago every

year. Thirty years ago its supply was drawn chiefly from the central and Lake States, at a freight rate into the city of less than $3 on the average thousand feet. In 1921, the great bulk of Chicago's incoming lumber was manufactured in the far South or the far West, and the average freight had risen to $13 per thousand feet. In other words, rising transportation costs have taxed this lumber market $20,000,000 a year. A study of lumber shipments into New York, Pittsburgh, Detroit, or any other of the large eastern consuming and distributing centers tells a similar story. Old lumber exporting States, like Pennsylvania and Michigan, now pay from 15 to 20 million dollars yearly in freight bills on the forest products which they are compelled to import. The cost of lumber transportation has steadily become a more and more dominant factor in the principal lumber markets of the country and hence in the quantity and character of lumber consumption.

The Great Plains and the Panama Canal now separate our only large remaining source of softwood timber from four-fifths of the population and nine-tenths of the manufactures in the United States. We are entering a period in the lumber business in which the transportation factor will be even more dominant than hitherto. And just as far as we can look ahead, its domination grows. When the virgin timber of the Pacific Coast is exhausted, the softwood forests of Siberia may become a controlling competitive factor in the lumber markets of America. Again the transportation cost will mount to a higher level and freight bills will weigh even more heavily in the retail price of lumber.

In other words, the amount of standing timber which we have left is much less important than its availability, as expressed by the cost of getting it in manufactured form to some consumer who wants it. Large quantities of timber in inaccessible mountainous regions of the West will not be active in supplying our markets for forest products for a long time to come because of the excessive cost of transportation, in the log and in manufactured form combined. They are not available. Indeed, they may follow the timber of Siberia in supplying the markets of America and influencing its prices on forest products, just as our western pulpwoods are following the pulpwood resources of eastern Canada in supplying the American paper trade. In short, the volume of timber remaining in the United States, the 2,200 odd billion feet of merchantable saw stuff which we estimate we still have, is not after all

the most important factor in supplying our requirements in forest products. It is secondary to the cost of transportation, which mainly controls the retail price levels and consequently determines when the stumpage of any particular region can enter the principal lumber or paper markets.

It is not true to the mark, however, to visualize our future timber supply as readily obtainable within a constantly widening circle of transportation costs as long as the consumer is willing to pay the freight bill. The United States hitherto has enjoyed undisputed control of all the standing timber it could possibly use, with the exception of small quantities of semi-precious or other specialty woods. Foreign competition for the products of our mills has been negligible in volume and without effect upon market prices for forest products. It has been within our political power to eliminate it altogether whenever we chose. This same condition will hold true for the duration of the softwood forests of the Pacific Coast as the mainstay of the national lumber market, although it is worthy of note that oriental competition for timber from these forests bids fair to become by no means a negligible factor in volume as well as a subject of political discussion.

Once, however, we are compelled to go beyond the United States for any important percentage of our forest products, we shall encounter world-wide competition and the story will be a different one. The pressure of population and modern civilization upon natural resources has no better illustration than the present world-wide situation as to supply and demand for coniferous timber. Mr. Zon's exhaustive survey of the forest resources of the earth has shown that the accessible coniferous timber of the world is not adequate to meet the requirements of the twentieth century. Once we have to look beyond our own borders for forest-grown material, on a large scale, we must compete with world markets that are short of raw materials for paper and construction lumber.

International competition for forest products will certainly grow more keen, rather than less, as time goes on. The Forest Service has received inquiries representing Norwegian, British, and Japanese capital looking to the establishment of paper mills in Alaska. The industrial growth of nations the world over has been signalized by a sustained increase in the consumption of paper and usually by a period of rapid advance in the consumption of lumber. Similar demands for forest products normally attend rising standards of living in any nation or increases in its

purchasing power. The Chinese now consume about one-tenth of a pound of paper per capita annually, the Russians about 6 pounds per capita, and the Japanese about 11 pounds per capita, as compared with 44 pounds in Germany, 75 pounds in England, and 149 pounds in the United States. The potential consumption of paper and lumber by the populous nations of Asia and eastern Europe, once their commercial development really gets under way, might well overwhelm the timber supply of the world within their reach.

In other words, when our own western forests are depleted to the point that we must penetrate into Asia or South America bargaining for timber, we will encounter far more than a new level of transportation costs. We will be met with stiff world-wide competition which is certain to establish price levels for lumber and paper in the consuming markets of the United States beyond anything we have hitherto experienced.

Now it is almost axiomatic that the transportation cost into any lumber market from the region which furnishes the bulk of its supply, once that cost is fairly established, is translated into higher stumpage values on locally grown timber which enters the same market. Anything that runs up the price of lumber or paper, like competition between different consuming regions, tends if reasonably stable to make what standing timber there is locally available worth more. The stiffer the competition New England encounters in stocking its lumber yards from the Gulf or the West Coast or from Siberia, the greater will be the price differential in favor of her own second-growth stumpage.

Many elements, of course, influence the movement of stumpage prices. But in a broad way, underlying the general rise in stumpage values in all forest regions during the past thirty years, the effect of rising transportation costs on lumber from more and more distant sources is discernible. It is particularly striking in the case of second-growth softwoods in regions accessible to large industrial centers, material which produces no specialty product and satisfies no high-grade demand but which must compete in the general market for low-grade construction or industrial uses. In new regions containing large supplies of virgin softwood timber, during any given period, the increase in stumpage values, while usually well sustained, has been relatively slow. But in almost every instance where enough second growth has been produced in old regions to become a factor in the lumber trade, its stumpage price has advanced at a much faster rate.

Extensive cutting of second-growth white pine in the New England States began about 1900. In the following twenty years the average stumpage value appears to have advanced from around $4 per thousand feet to nearly $10 in Maine and to $16 or more in Maassachusetts and New Hampshire. In extreme cases second-growth New England pine has brought $25 on the stump, a price as high as that obtainable for old-growth white pine stumpage in the Lake States. A similar story may be told of the portion of the southern yellow pine region which was first extensively cut, the coastal plateau belt extending from Maryland through North Carolina. In the last ten years second-growth pine in this region has climbed in value on an average from about $3 to at least $7 a thousand feet. During the war its average price reached $9 and individual tracts were sold for as much as $14 a thousand.

The cost of transportation from a more distant source of timber has created these stumpage values for locally produced second growth. The same factor has accelerated the increase in stumpage values on virgin timber in each of the main forest regions of the country toward the end of its period of active exploitation. When the main source of all-purpose softwood lumber shifted from the Lake States to the southern pineries, the stumpage still left in the Lake States profited by the freight differential between that region and the new region which rapidly dominated the old markets. The same thing is traceable in southern yellow pine today, with the gradual shift of the main source of our all-purpose softwood lumber to the far West.

I have purposely taken illustrations from the class of material which is consumed in the largest quantities and which consequently reflects the most general and stable basis of timber values. Illustrations far more striking could be taken from second-growth hardwoods which supply limited and specialized markets and also from wood entering into the manufacture of paper.

The broad application of the creation of higher local stumpage values equivalent to the differential in transportation costs to our future timber supply is obvious. Region by region this process leads inevitably to a point, some point, where plan-wise timber growing becomes commercially feasible and is well-nigh compelled by purely economic forces. The shifting of our principal source of softwood lumber to the West Coast is setting a new price level in favor of locally grown stumpage. Lumber charters from Puget Sound or the Columbia River through

the Panama Canal to the upper Atlantic Coast seem to have settled for the present at between $15 and $18 per thousand feet. That differential in favor of competing timber grown in the Northeastern States is certain to exert a powerful commercial pressure for timber culture.

Next to the transportation situation, the question of outstanding importance in relation to our future provision of timber is the amount of land that will be available for growing it and to what extent timber culture must compete with other forms of land use. Four hundred and seventy million acres of land, about one-third of the soil of the United States, is now in forest, cut-over land, or abandoned farm land that once supported timber. The belief has been common that this acreage of actual or potential timber-growing land would be steadily whittled down by the extension of agriculture. As a matter of fact the tide of land-clearing for cultivation ebbs as well as flows. The total acreage of improved farm land in the country has increased steadily from census year to census year; but in many regions it has been decreasing as a broad trend during the past four or five decades. Between the last two census years there was a net increase in farm acreage of 28,000,000 acres, but in nineteen States, embraced mainly within the original forest belt east of the Mississippi River, the acreage of improved farm land decreased and in six other States it remained stationary. New England lost 32,000 farms during this period, with a net decrease of over a million acres under tillage. As a matter of fact, the increases in our national acreage of improved farm land are now coming from the regions which were never forested. Within the original forest belts of the United States the net acreage of cultivated land is shrinking. The area of potential timber-growing land is increasing. The abandonment of more hill farms bids fair to at least offset the clearing of fertile valleys still in timber or stumps.

From what the farm economists prophesy as to the future trend of agricultural development in the United States, the abandonment of farms in timber growing regions is apt to be accelerated rather than diminished. American agriculture is going through a terrific shaking down. Its leaders preach the gospel that success lies in concentrating farm labor and farm capital upon the most fertile and most favorably situated soils; that instead of producing our wheat crop at the rate of 13 bushels to the acre we should produce it on half as much land at the rate of 30 bushels per acre, with a corresponding increase in inten-

sity of fertilization and cultivation. The drive for scientific farming, the use of better machinery, the putting of agriculture to a business test of profit and loss are all tending to concentrate agriculture upon the more productive soils in the more favorable situations for access to market. The poorer and rougher and less accessible lands are going to drop out, the acres close to the profit-and-loss line will be thrown into the discard.

If this conception of the future development of American agriculture is sound, timber culture is not going to meet much competition in the use of at least one-third of the land area of the United States. Other forms of land use, such as the rearing of livestock, will of course enter the competitive field to some extent. But it seems to be a reasonably safe prediction that the tendency for another generation at least will be to adjust the economic status of at least one-third of our soil to timber growing as its principal crop. This will mean a gradual adjustment of the value of land of this character to the profits obtainable in growing timber. The adjustment of taxes on such land to timber growing as its principal crop will follow almost inevitably. Timber growing may indeed compete successfully for considerable areas of land that have a marginal value for farm crops just as it has done not infrequently in countries of the Old World. But the fact that we are likely to have 470 million acres, more or less, of land that will be largely without a crop unless timber culture gives it employment is an economic factor of the first importance in relation to our future supply of forest products.

There remains what doubtless is the most crucial point of all; namely, the probable demand for timber products. The United States has already passed through a cycle of rising and falling per-capita consumption of lumber. From 345 board feet in 1870 it rose to 516 in 1906 and dropped to 316 in 1920. Although the World War was largely responsible for the more recent and more abrupt portion of this decline and while the per-capita consumption of lumber will doubtless rise when economic conditions permit satisfying the current demands for housing and industrial construction, nevertheless the drop in per-capita use of lumber from the peak of 516 board feet in 1906 indicates a normal reaction arising from the higher cost of lumber and from the slowing up of new settlement and new industrial developments in their ratio to population. The reduced consumption of lumber also reflects

the substitution of other materials where wood was formerly used, by reason of their lower cost or their better adaptation to construction requirements, particularly in large urban centers. A large substitution of coal, oil, and electric energy for fuel wood, which still forms 40 per cent of the forest-grown material consumed in this country, has already taken place and is bound to increase.

Some of my associates who have given this matter the closest study estimate that with a present yearly consumption of 22 billion cubic feet of standing timber for all purposes, the substitution of other materials for wood is taking place at the rate of something less than one-half billion cubic feet annually. Higher levels of lumber prices doubtless will accelerate such substitution as well as reduce the consumption of forest-grown materials where no substitutes take their place. I anticipate that when the bulk of our western coniferous forests have been put through the sawmill and the United States becomes partially dependent upon foreign sources of timber for a considerable period until new crops of wood can be grown on our own land, there will be a material and enforced drop in per-capita consumption. But as long as the United States retains its dominant characteristics as an industrial nation, there is bound to be an active demand for wood in one form or another that cannot long be repressed and that is bound to obtain wood by growing it at home or shipping it in from abroad within any reasonable limits of cost.

A large part of our present consumption of wood is industrial consumption, material that does not go into the primary requisites of housing and fuel but into manufactures of one sort or another. The sharp advance in the per-capita use of lumber in the United States prior to 1907 reflected the tremendous increase in lumber used for manufacturing purposes, railroad building and the like, fully as much as the demand for more buildings. The per-capita timber requirements of the nations of Europe which are advancing industrially are increasing, not diminishing. This has been very plain in the history of Great Britain during the last 70 years. It is bound to be true of the United States where the industrial use of wood has attained a greater volume and variety than in any other nation, where new products and processes involving the use of wood have come thicker and faster than in any other part of the world, and where living standards involve a dependence upon forest products to a degree nowhere else attained, as for example

in our consumption of paper. It seems to me a reasonable conclusion that while the per-capita use of wood in the United States will doubtless decrease still further, and while our total consumption of forest products may drop sharply during the period of readjusting the source of timber supply from virgin forests to second growth, yet in the long run there can be no material reduction in the present aggregate demand for wood at a price level sufficient to make timber growing commercially feasible on the greater part of our non-agricultural lands.

The United States now consumes, including its exports, about 22½ billion cubic feet of timber annually, or about 212 cubic feet per capita. This includes fuel wood, pulp wood, railroad ties, fencing, mine timbers, etc., as well as lumber. We have at present 470 million acres of forest land or potential forest land, a figure not apt to be greatly reduced by the extension of cultivation. In the light of European experience it seems reasonable that this land area, averaging bad acres with good, can produce under intensive forest practice the equivalent of 58 or 60 cubic feet of wood annually. That would make the yearly production for the entire country 27 billion cubic feet, with a leeway of about 5 billion cubic feet over present consumption. Timber growing is practically without a competitor in the use of this land. Already the rising transportation costs from distant forest regions have brought portions of this land, particularly in the northeastern States, into use for growing timber under intensive methods. Every year the still rising cost of transportation, with its reactions upon public policy, tax laws, fire protection provisions, etc., will widen the acreage of land used for growing forest crops under more or less intensive methods. It is spreading over New England and the Middle Atlantic States. It is creeping down the Atlantic seaboard. It is making gains on the Gulf Coast and in the Lake States. Even on the Pacific Coast, where virgin timber is still plentiful and cheap, systematic timber growing is beginning at exceptionally favorable points, like the redwood belt of California.

Forestry is not wholly a matter of cold economics. The northern races of the world were forest-bred. The forest gave them their Christmas trees, open wood fires, and love of the chase. The sentiment for forest preservation and forest growing is instinctive. The forward nations of the world have been quick to recognize the public interests jeopardized by forest destruction and to safeguard them by legal principles which

transcend the laissez-faire doctrine of political economy. And the people of the United States, who lead the world both as users of wood and as lovers of the wild places, can least of all afford to view their forest problem solely as an equation of supply and demand.

Nevertheless there must be and there is solid economic ground for timber growing, with reasonable backing in public policy, as a permanent form of land use on all fours with scientific agriculture. It is fruitless to try to put the whole puzzle together at one sitting. No one can lay out an orderly plan, according to economic formula, for shifting our source of timber from the supplies stored up in virgin forests which are sought and mined out in the order of their accessibility, like coal deposits, to successive timber crops grown in the 39 States which contain large areas of forest land. Yet in a broad way this is exactly the change that is coming about and, as far as our present experience goes, putting the consumer's money into growing trees in his own State instead of transporting lumber from sawmills 2,000 or 3,000 miles away will shift the source of supply from a temporary basis to a permanent one, without materially increasing the cost of forest products to the user and without necessitating any permanent reduction in our use of wood.

BIRCH SUCCESSION IN SPHAGNUM BOGS

By George B. Rigg

Professor of Botany, University of Washington

The western birch (*Betula occidentalis*) is found to be a successful invader of sphagnum bogs in Whatcom County, Washington, particularly in their later stages of natural succession or when modified by burning, clearing, drainage, or pasturing.

A sphagnum bog is, of course, merely a stage in succession, and instances where an area is approaching this stage or has recently passed it are common. Sphagnum bogs are commonly invaded by trees, and in the later stages of succession, the trees may become so numerous as to form a forest.

Coniferous trees are commonly the first and most successful invaders of the bogs of the Northwest Coast, deciduous trees rarely gaining a foothold.[1] The peat bog birch (*Betula glandulosa*) is common on the borders of bogs in the Puget Sound region and British Columbia, but it is too small to have any commercial value. The western birch, however, is a large tree of commercial importance and is found to be a successful invader of bogs in northwestern Washington. The writer visited seven bogs in the western portion of Whatcom County in September, 1922, and found this species extremely abundant in three of them, common in two more, and present, though rather scarce, in the other two. He has also found it in an old bog at Victoria, B. C.[2]

This birch is common in northwestern Washington and southwestern British Columbia. Sudworth [3] says that it is the largest known species of birch, reaching a height of 80 to 90 feet and a diameter of 2 to 3 feet. Whitford and Craig [4] state that the birches of this group in British Columbia "are evidently a remnant of what was once a more important deciduous forest, and where found growing now they should be carefully preserved." Persons familiar with logging in the vicinity of Bellingham, Washington, state that logs 12 inches in diameter have

[1] Rigg Journal of Forestry, 15: 726-739. 1917.
[2] Ecology, 3: 207-213. 1922.
[3] Forest trees of the Pacific Slope. U. S. Forest Service.
[4] Forests of British Columbia. Commission of Conservation, Canada, Ottawa, 1918.

commonly been cut and that logs 18 inches thick and 40 to 50 feet long have not been uncommon. The lumber is in good demand for furniture and other uses.

The Custer bog has an area of 300 acres or more and lies just east of Custer. Part of this bog is in a very early stage of succession, where sphagnum is growing forward into a rather sparse swamp forest and the usual bog vegetation of cranberry (*Oxycoccus oxycoccus*), sundew (*Drosera rotundifolia*), Labrador tea (*Ledum groenlandicum*), and swamp laurel (*Kalmia polifolia*) are either with it or following close behind. Here birch trees 15 feet or so in height are common in both the swamp forest and the young bog. Where they occur in the bog, however, they seem to be remnants of the swamp forest rather than invaders of the bog.

In the more mature portions of this bog there is a dense growth of lodgepole pine and no birches were seen. The writer did not go over the whole bog, but the two conditions mentioned were characteristic of all portions of it that were seen.

The Marietta bog is about 5 miles northwest of Bellingham and has an area of approximately 4 acres. Both the bog and the coniferous forest surrounding it have been almost completely burned. The burning of the bog occurred long enough ago so that the bog association has restored itself, probably from small unburned patches in some places and from surviving underground portions of bog plants in others, but the surrounding forest and much of the marginal ditch of the bog have been burned so recently that they are at present largely bare of living trees. There are very few birch trees in this bog and even these are small and near the margin. One factor in the scarcity of birch here may, of course, be the destruction of trees by logging and burning so that no seeds were available when the bog was restoring itself.

The Pangborn bog and the Goshen bog are both on floating mats of vegetation at the margin of lakes. The former is at Pangborn Lake, about 5 miles northwest of Everson, and the latter is at Silver Lake, about a mile northwest of Goshen. Birch and lodgepole pine grow together in both of these bogs, but both species are small, ranging from seedlings to trees 6 or 8 feet tall.

The Dickey bog has an area of about 5 acres and is located near Wahl, about 10 miles northeast of Bellingham. Forest succession in this bog has reached a very late stage, conifers being abundant and birch fairly common. Birch seedlings are extremely numerous in a

portion of this bog that was burned a few years ago, and conifers are small and scarce. If nature is allowed to take its course, the birch will evidently be the dominant feature of the climax vegetation on this burned area.

In the Ferndale bog the growth of birch seedlings is especially dense. This is a small bog, having an area of only an acre or so, and is at the border of the town of Ferndale. The forest which formerly surrounded this bog has been cleared and the bog has been drained. The birch seedlings are only a few inches tall, but they are so numerous that they practically cover the surface in places. Coniferous trees are common in this bog but the coming succession is birch and a dense thicket of this will cover the bog in a few years if the area is not further disturbed.

Birch succession in the Dalstrom bog is in a little later stage than in the Ferndale bog. This bog has an area of about 10 acres, and is located near the county farm between Bellingham and Ferndale. It has been greatly modified by drainage and pasturing and is now much grown up to brush and tall herbaceous plants so that the conditions for young birch seedlings are not so favorable as in the Ferndale bog, but there are dense thickets of young birch trees 4 to 8 feet tall in several places and there are occasional trees 15 feet tall.

Since the western birch is found in every one of the seven bogs visited in the western portion of Whatcom County it would seem that it is fairly characteristic of the bogs of that region. It seems quite evident that this valuable tree tends to occupy sphagnum bogs in this region in later stages of succession, and the conditions seen indicate that this birch succession may be hastened by draining the bogs and possibly also by other means such as burning or by clearing away other trees and brush.

CUTTING METHODS IN NORWAY PINE[1]

By T. Schantz Hansen

Cloquet Forest Experiment Station, University of Minnesota

Norway pine can readily be classed as one of the disappearing trees of the Lake States from an economic standpoint. It would seem, therefore, that very little study of cutting methods is warranted. The remaining stands are to quite an extent on public lands and the quality of material produced is such that there will always be a demand for it. The demand being there, the product will be produced even though it necessitates planting. It therefore behooves foresters to have knowledge about cutting methods, to reduce the need for planting to a minimum through a proper removal of the old stand. Considerable work has been done on planting methods, but very little has been done on cutting methods. The data in this article serve only as an indication for further work, not as something on which to base final conclusions.

During the course of a survey of cut-over lands in Lake County, Minnesota, the writer encountered a stand of young Norway pine of striking density and distribution. This stand was located on Lot 1, Sec. 14, T 65 N R 7 W 4 P. M., on the shores of Knife Lake. This region is in the rock outcrop region where ledges of granite rock are covered with scant layers of soil.

A closer examination of the area showed that it was one where nature and man had accidentally combined to practice forestry. Some of the original stand remained and from this and the reproduction considerable of the history of the stand was learned. The trees left after cutting are now 150 years old; fire scars showed that a fire had gone through the stand about 50 years ago. Just how much this opened the stand it is difficult to say. About 35 years later the bulk of the stand was removed by logging. It was impossible to learn the exact date of cutting. The slash had been left after logging and no fire had been through the stand since the one 50 years ago.

[1] Published by permission of the Dean of Agriculture, University of Minnesota, as Paper No. 356, Journal Series.

A plot one chain wide and five long was laid out in a typical portion of the area. The standing trees were measured and tallied, the stumps were measured and tallied, and the reproduction counted and measured. Enough ages of reproduction were taken so that an indication of the various age classes of reproduction could be determined. The area of the plot was one-half acre, but all the data have been put on an acre basis as this is the common and accepted standard.

THE STAND

It would help a great deal were it possible to tell just the number of trees and the volume removed by the fire. The logging operation removed 150 Norway pine trees and four cedar trees. The total volume removed was approximately 12,000 board feet. There were left four white pines and thirty-eight Norway pines, giving a total volume of 800 board feet. The diameter of the trees left varied from 4 to 13 inches, the greater number lying between 4 and 6 inches. In addition to the Norway and white pines left there were ten birch, twelve popple, and twenty-four spruce, all above 4 inches in diameter. This gives a total of 242 trees per acre after the fire of 50 years ago. It can readily be seen that it was not a heavy stand either from the standpoint of number of trees per acre or volume. Much of this rock outcrop area supports only a fairly light stand.

Less than 10 per cent of the stand by volume was left after cutting and these were only the culls and defective trees.

REPRODUCTION

The reproduction on this area is striking because of its desirable density, proper distribution, and thrifty appearance.

In recording the reproduction the same classification was used as in the cut-over land survey—seedlings up to 10 feet, saplings 10 feet to 20 feet, and poles 20 feet to 4 inches in diameter. There was a total of 1,770 trees per acre in the reproduction. They were divided as follows: 1,164 or 65 per cent were seedlings, 528 or 30 per cent were saplings, and 78 or 5 per cent were poles. Seven different species were found in the reproduction. Norway pine was the most prevalent with 576 per acre or 32 per cent of the stand; white cedar was next with 484 per acre or 27 per cent of the stand; white birch came third with 226 per acre or 13 per cent of the stand; black spruce came fourth with 210 per acre or 12 per cent of the stand; white pine came fifth with 200 per acre or 11 per cent of the stand;

quaking aspen came sixth with 72 per acre or 4 per cent of the stand; while jack pine came seventh with two per acre or 1 per cent of the stand.

The reproduction varied in age from 4 years to 50 years, showing that there was considerable reproduction before cutting. Reproduction which was over 20 years old showed a period of suppression from which it was released by the cutting some 15 years ago. On the basis of the trees of which the age was determined, thirty in number, it was found that 40 per cent of the reproduction came in before the final cutting and 60 per cent afterward.

SLASH DISPOSAL

The slash had not been disposed of by either lopping or burning. At present the slash presents no fire hazard, being in a very advanced stage of decay. There is a good layer of humus and considerable brush as ground cover, not enough to make serious competition for the reproduction. In fact, where such a good stand of reproduction is established and on such thin soil an understory of brush is beneficial in helping to conserve moisture.

CONCLUSIONS

From the rather fragmentary evidence of this small plot it would seem to indicate that Norway pine should be removed in two cuttings. The first one being very light, probably about 20 per cent; the second one taking the remainder, probably some 10 years later. The establishment of 40 per cent of the reproduction in the above plot after the opening effect of the fire of 50 years ago indicates that this can be done. All of the reproduction was thrifty and uninjured, showing that logging can be accomplished without injury to the advance growth.

The slash should not be burned except in cases where the hazard is great and then only in compact piles when the ground is covered with snow. By not burning the slash two things were accomplished on the plot: Unmerchantable trees, 4 to 6 inches in diameter, were left to develop and serve as a basis for future cut or larger sizes in the new stand; there was a total of 88 such trees on this plot, over half of which were Norway and white pines. The composition of the young stand was kept predominantly of the more valuable species instead of converting it to a birch, popple, balsam mixture as usually happens after disposing of slash by a running fire.

The striking thing to notice about the reproduction on this plot is 5 per cent popple and 1 per cent jack pine, both species requiring mineral soil and full light for optimum development.

Finally, then, the indications are that Norway pine should be removed in two cuttings, a light one followed by a heavy, and that brush be not burned. This, of course, is not final, but merely an indication based on facts that have happened and is of value chiefly as a guide for further work.

A SUGGESTION FOR FOREST REGIONS AND FOREST TYPES AS A BASIS OF MANAGEMENT IN NEW YORK STATE

By Harold Cahill Belyea

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As a means of getting back to the idea of a policy involving the practice of forestry for the whole of New York State, the following is offered. It contains little or nothing original either in matter or concept. It mainly seeks to bring to a focus the various problems of forestry in the State as a whole with emphasis on no one forest region. At the same time it should be pointed out that only effective progress will be made when it is recognized that forestry in New York State cannot be solely a State issue. The failure to co-ordinate and harmonize the New York policy with similar schemes in adjoining States, which are also for the most part forest States, will presuppose at least very slow progress and even possible failure of a definite forestry policy.

With the foregoing in mind the following scheme of forest regions, forest types, and forest management is here suggested. To illustrate the scheme more fully a map of the State with the various forest regions delineated is appended. Study of this figure is urged before proceeding to consideration of the rest of the material. In the development of these ideas three objectives have been kept in mind:

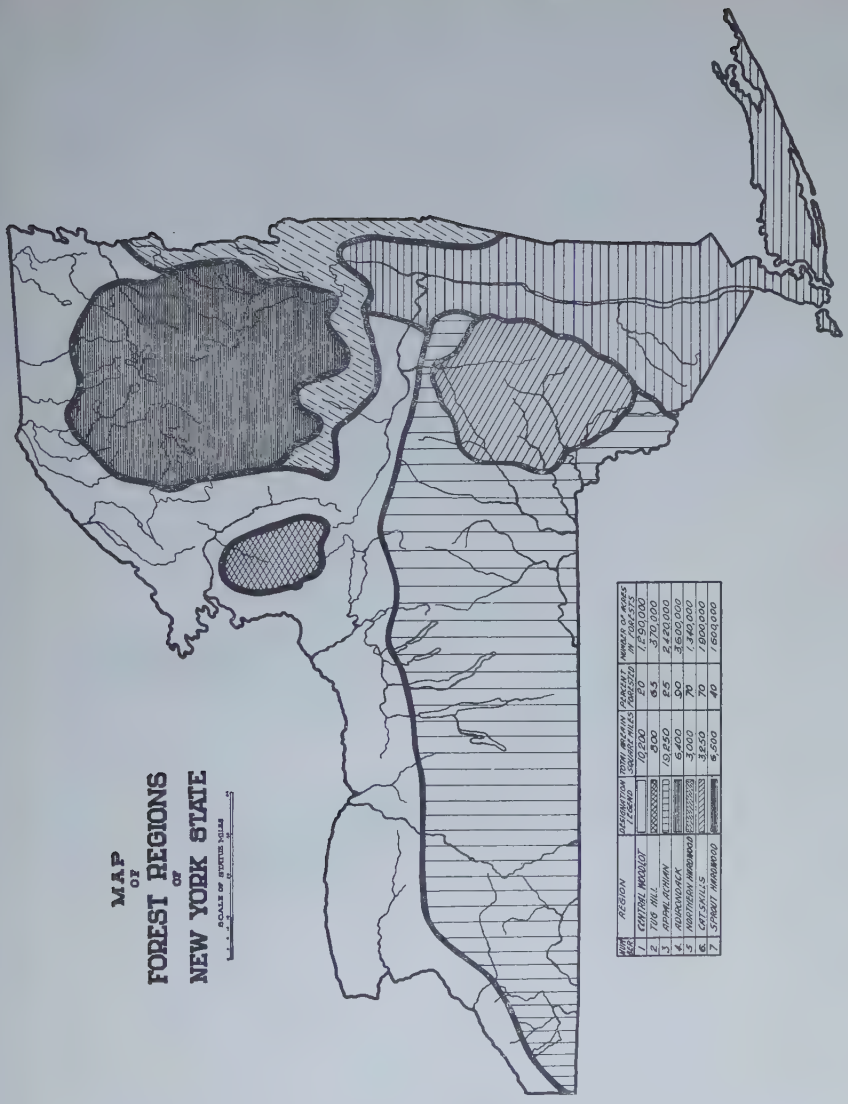
1. To make a segregation of forested areas based on similarity of dominant and indicator species.

2. To co-ordinate this segregation on the geological physiographic units from which the forest soils are derived.

3. To harmonize this segregation with the standardized forest regions of surrounding States.

CENTRAL WOODLOT REGION

This region is mainly located on the geological physiographic units of the old Erie-Ontario-St. Lawrence Lake Plain, the Black River



Valley, and the upper and central portion of the Mohawk Valley. It represents a region primarily agricultural in its development and yet one in which probably not less than 20 per cent of the area is in forest. These forested areas occur in swamps too expensive to drain, on rocky knolls where the soil is too shallow and too dry for farming, and in farmers' woodlots left as such.

The topography of the region, a plain, is generally level or undulating, depending upon the presence or absence of moraine structure. This fact too is derivative of the soil which may be sand or gravelly loams on the flats and lowlands or clays and till mixed with stone on the low lying ridges. While the region on the whole is well drained, swamps and semi-barren or abandoned areas are not uncommon. The region is not an absolute forest region but is of great importance in any State scheme of management, due to its accessibility to adjacent intensive industrial centers.

Forestry in this region must primarily be a woodlot proposition. While the region and the soil are both favored by the pines, it is believed the three hardwood species, white ash, basswood, and red oak, should be favored because of their quick growth, good sprouting abilities and general utilization purposes. Management should seek this development through one of the coppice methods.

TUG HILL REGION

This region, while the smallest in aggregate area, is nevertheless one of the most interesting, diversified, important, and at the same time the least known of any section of the State. It is located on that northern outflung prong of the old Appalachian plateau which was cut off from the main portion by the drainage through the western outlets of the post-glacial Lake Iroquois. The surface is that of a typical plateau bounded by an escarpment of considerable abruptness on all sides especially on its eastern and northeastern faces. Erosion and dissection since glacial times seems to have progressed rather slowly except on the edges of the escarpment where the egress of the Salmon River and Sandy Creek on the western face and of the Mohawk and the feeders of the Black River on the eastern are marked by rather deep narrow gorges.

The underlying rock structures are the shales, sandstones, and limestones of the main Appalachian plateau, over which has been laid a rather thin sheet of drift, principally clays. More than 30 per cent of the area is in swamp.

The region is of intense interest to the forester, not only because more than 65 per cent of the area is in forest but because of the fact that its forest condition is a complex, rendered so by the fact that it is a meeting ground of four important forest regions, namely, the northern Appalachian region in its most northerly projection with its oaks,

hickories, and basswood; an easterly projection of the central woodlot with its walnut, elms, and butternut; a westerly projection of the northern hardwoods region which has thrust itself westward through the southern foothills of the Adirondacks and across the Black River Valley, with its typical beech, birch, maples; and a westerly projection of the Adirondack forest with its spruce and balsam forests.

The resultant forest hence is a complex, both of species and types. Mixtures occur in forest condition which, it is believed by the writer, are duplicated nowhere else, as for example the association of butternut and beech on ridges. The surprising thing about it is that the region has apparently escaped the attention of foresters on one hand and ecologists on the other. The writer admits his inability to either differentiate forest types or specify species to be favored. The suggestion is made, however, that an intensive study of the region with these points in mind be undertaken in the near future.

NORTHERN APPALACHIAN REGION

This is the most extensive purely forest region in the State, covering some twelve million acres. Physiographically speaking it is regular peneplain thoroughly dissected by stream action. Its westerly and northerly face is a steep escarpment rising abruptly from the Great Lakes plains and the Mohawk Valley. Its easterly projection is marked by the Heldenberg Mountains, the foothills of the Catskills, and the western Highlands of the Hudson. Steep slopes and deep valleys prevail. Ridge tops are rather broad and more or less elongated on a north and south axis.

The underlying rock structures are principally limestones, sandstones, and shales, over which is laid a smooth, thin, and locally stony, sheet of glacial boulder clay. Throughout the western portion of the region a large proportion of moraine structures occur as well as fluvic glacial eskers, drumlins, and the like. The soils are much deeper in valleys and of more variable composition. A large proportion of the soil material is glacially derived from the underlying shales, which weathering into clay greatly increases the fertility of the soil by increasing its water holding capacities.

Practically none of the original forest can be found. Woodlot ownership in greater or small parcels prevails. Approximately 25 per cent of the area is forested, the rest having been cleared for cultivation. It

is to be remembered that the stony upland soils are relatively infertile and an extension of the forested area is to be expected and is to be desired from an economic standpoint.

The original forest consisted mainly of white pine, hemlock, and hardwoods, of which latter the chief were chestnut, beech, oaks, maples, basswood, tulip, cherry, and cucumber tree. In the removal of the original stand, white pine has almost completely vanished. The chestnut has been removed by the blight, and cucumber as an important tree occurs mainly in the western portion of the region. Beech, oak, basswood, and black cherry seem to be the most important trees in future forest development.

Management at present seems to be mainly a woodlot problem, but with the extension of the forest growth more extended forested areas are to be expected on the ridge tops running along their main axis. Valleys, it is expected, will always be given over to agriculture.

Practically no virgin timber exists, in consequence of which consideration must be given to second growth. Four permanent forest types are to be recognized, namely: (*a*) Mixed hardwood, (*b*) pine and hemlock, (*c*) hardwood swamp, (*d*) softwood swamp.

Mixed Hardwood.—This is by far the most important type within the region both through its occurrence and from a commercial standpoint. Oaks (red and white) occurring in a mixture of basswood, beech, hickories, maples, and cherry, are commonly found. The stands are all aged, and where the tolerance of the species permits, a group selection method could be followed. This should be carried out on a conservative basis as influenced by the market conditions on one hand and the general health of the woodland on the other. If small timber on a short rotation is desired clear cutting with coppice reproduction can be followed. As has already been pointed out, the region is mainly an agricultural one and considerable quantities of small timber will probably be desired for fencing and fuel. Brush should be lopped in order to reduce the fire danger in dry summers. Grazing should not be allowed in wooded areas.

Pine and Hemlock.—The general distribution of this type seems restricted mainly to the southern tier of counties of the State. It is to be pointed out that this type contains a considerable representation of rather intolerant hardwoods such as cucumber tree, black birch, black cherry, as well as the more tolerant red oak, basswood, yellow birch, and pine

and hemlock. Management will depend upon the species to be favored. Due to its quicker growth and higher yield per acre, it is believed that pine would yield better returns. To achieve the best development of the type and species clear cutting with planting is advised. On account of the more inflammable character the pine brush and the drier climate of this region, brush should be piled and burned in the winter.

As a general thing management should seek to replace the hemlock on account of its slow growth and inferior quality. The encouragement of the latter as a timber tree should be restricted to thin soils and inaccessible locations and on protection sites. It is to be remembered that in this region forestry must be extensive in character, the chief objective of which is to seek the development of the best species for its sites; that is, to increase the pine and where feasible to replace the hemlock with pine.

The occurrence of this type is relatively restricted to the southern edge of the State on the southern uplands of the Susquehanna and Alleghany Rivers. It is of such importance as a commercial type to justify full consideration wherever met.

Hardwood Swamp and Softwood Swamp.—As a rule these types are found on lands of potential agricultural value and hence their area will be of decreasing importance from a forestry point of view. No scheme of management is at present suggested.

ADIRONDACK FOREST REGION

So much has been written concerning the Adirondack forests that the writer hesitates to add anything more, since addition can only result in repetition. It is to be remembered that the region is founded on a small but distinct and typical mountain system. It is founded a nucleus of metamorphic gneisses and schists interspersed with belts of limestone and gabbro elevated through a surrounding matrix of marine sedimentaries. Elevations run the highest in the State with pointed peaks of bare rock ledges of alpine characteristics contrasted with deep valleys and steep descents. Dense forests clothe valleys and mountains alike up to tree line. The amount of agricultural land within this region is practically nil.

Four major types of forest are recognized within the Adirondacks which may be briefly summarized: (*a*) Spruce swamp, (*b*) spruce flat, (*c*) mixed hardwood, (*d*) spruce slope.

Spruce Swamp.—The swamp type of the Adirondack region is a balsam and spruce mixture on poorly drained land. The soil may be deep or practically lacking, as on some boulder formations, but the permanent water table is generally so high as to make natural swamps a poor site for tree growth. The floor of the forest is spongy with common occurrence of sphagnum. The upper margin of the swamp may be defined as the line at which a soil layer of depth sufficient to sustain natural hardwoods exists above the water table, and where the floor of the forest loses its spongy character.

Spruce Flat.—This type may be crowded out in some places by the abrupt approach of steep hardwood slopes to the edge of a swamp, and again the spruce flat may cover extensive areas around the swamps on the flats, knolls, and lower ridge slopes. The lower margin extends to the edge of the swamp, stream, or lake and is marked by the appearance of soft maple and birch on a moist soil covered with humus and lacking the spongy characteristic of the swamp.

The upper margin is marked by the disappearance of balsam and appearance of beech in the mixture. The soil loses its humus covering, and there appears instead a shallow layer of hardwood leaf mould with a firm, well-drained soil beneath. The characteristic species are red spruce, balsam, hemlock, yellow birch, and red maple. Birch exceeds in number all other hardwood species in the type. The predominance of softwood species, and moist condition of soil when shaded, and extreme dryness when not shaded, influence to a marked degree the amount and character of reproduction to be expected.

Mixed Hardwood.—This type extends from the margin defined in the foregoing up the slopes to a point where spruce again appears as a dominant. Beech, yellow birch, and hard maple are the dominant trees, though there is a wide variation, and on moister sites soft maple and even black ash will be found in the mixture. In this hardwood mixture are to be found spruce, hemlock, and an occasional white pine. The amount of moisture and soil depth both influence the composition. The lower, moist, hardwood land will have more birch than the better drained parts. Areas of several acres may be found covered by stands of pure sugar maple, while shallow soils on exposed ledges are pure softwood, largely hemlock.

Upper Slope.—This has been defined as to its lower margin as that point in elevation in the mixed hardwood forest where spruce again

becomes a dominant. As a softwood forest the type extends over the upper slopes and mountain summits, grading off, in its upper limits, according to elevation and locality, into the typical stunted growth of a sub-arctic or alpine type of vegetation. Paper birch is the most widely distributed and best developed hardwood tree of this type. It can thrive better than maple or beech on the thin soils, and can reproduce best of all hardwoods in the deep humus found under the type.

Management on this region more than any other should not seek prescription but results. Enough has been written on this subject to summarize at least the writer's opinion in a few brief paragraphs.

1. The spruce swamp areas seem to be able to take care of themselves and lend themselves naturally to clear cutting methods followed by natural reproduction.

2. The delicate equilibrium exhibited by the spruce or balsam flat areas, their susceptibility to windthrow, and their high degree of liability to mortality from exposure, indicate the application of a modified selection system on a conservative basis.

3. In the management of hardwood areas the fundamental policy of the owner in relation to species to be favored must be known. If the hardwood species, beech, yellow birch, and maple, are to be favored, present logging methods approximating clear cutting will be followed by adequate regeneration as long as fire is kept out. Where the softwood species are to be favored and natural regeneration is desired it can best be achieved by the most conservative of selection cuttings. Failing this and still desiring the softwood species the only feasible scheme would be absolute clear cutting followed by planting.

4. While the upper spruce slope will show adequate regeneration of softwood species after logging, they lack the natural fire protective feature of moister soils. Consequently, logging within this type almost always produces a very severe fire hazard. Furthermore, their general character, slope, location, and accessibility make economic logging of any degree within this type a matter of extreme doubt. It is believed that at least at present the general welfare of the forest and forestry can best be maintained by the urging of the segregation of this type into pure protection forests only.

5. Planting on burned-over areas should be undertaken before the native growth of weeds, ferns, and brush offers such competition to the

planted stock as will induce very early stagnation and probable extinction.

6. Planting on cut-over lands gives little promise of success unless the area is given a preparatory treatment by burning for the purpose of clearing the site of native seedlings and sprout growth. Even then a secondary silvicultural treatment will be necessary in order to remove competing fast-growing hardwoods subsequently seeded into the area.

NORTHERN HARDWOOD REGION

This region although sixth in area is probably third in order of potential importance in the State. Its total area within the State is approximately two million acres, located partly in the Eastern Highlands of the middle of upper Hudson and partly in a westward outthrust through the southern foothills of the Adirondacks and the northern uplands of the lower Mohawk. Its potential importance lies in its strategic location in regard to markets and main transportation routes and to the fact of its relatively large amount of forested land.

Within its confines this region forms a narrow belt of forest land 50 to 60 miles wide at its greatest extent. Probably 70 per cent of the area is forested, and it is more broken in its distribution than in the adjoining Adirondack region. While main stream valleys are cleared, secondary streams and feeders are found forested. It should be recognized, however, that there are in this region some areas of agricultural land still forested but it is doubtful if this amounts to more than 15 per cent of the total, and its withdrawal from forest is only expected to be a matter of rather slow progress consistent with the economics of agricultural development in this section.

The topography of this region while not rugged is rough and hilly, presenting considerable contrast and relief. Streams and valley bottoms show a considerable erosion gradient. The underlying rocks are principally granites, schists, and gneisses. The soil covering is a fairly thick blanket of glacial deposition interspersed with loose rock from which is derived the sandy clays and loams characteristic of the region. A considerable proportion of the soils might be classed as agricultural, at least for grazing purposes. The distinction between farm and forest soils will for some time be based on the amount of loose stone in the surface soils.

The forest is more broken in its distribution than in the Adirondack region by cleared valleys used for farming. The forest is characterized by a mixed growth of tolerant hardwoods, conifers occurring only in a small proportion. Sugar maple is the predominant tree, with beech and yellow birch next in importance. Red oak, basswood, ash, and black cherry are found in the mixtures.

Three types, permanent in character, are only of importance: (*a*) Upland hardwoods, (*b*) hardwood swamps, (*c*) softwood swamp.

Upland Hardwood.—This is the most important forest type, both on the basis of distribution and value of commercial species. The soils are usually of good depth and fertility on which account an excellent growth of timber can be produced. Reproduction is easy to maintain naturally, the determining factor seeming to be the admitting of light to the forest floor. Hard maple, which without doubt is the species to favor, excels all others. White ash should also be favored where it occurs. The heavy soil cover of deciduous leaves deters any great reproduction of conifers. Both high forest and coppice systems of management could be applied with success.

Hardwood Swamp.—Of the two swamp types the hardwood swamp is the more important. Black ash and soft maple are the most important species and should be favored in management. Some form of coppice would probably be more successful due to poor seedling reproduction conditions, and slow growth caused by an excessive water supply.

Softwood Swamps.—Limited in extent and of decreasing importance due to the seizure of these areas by hardwood species after logging, black ash and soft maple are associated with spruce and balsam in this type and assist in producing a seed bed quite unfavorable to coniferous reproduction.

Within this region it would seem that the hardwood species, and especially hard maple, are to be favored.

SPROUT HARDWOODS REGION

This region is third in importance on the basis of area within the State as well as by the fact that it is only excelled by the Adirondacks and Catskills region in containing a fairly large proportion of absolute forest land, probably 40 per cent of the region.

Its occurrence within the State is bounded mainly by the eastern and western highlands of the Hudson Valley as far north as Warren County. In the Mohawk Valley there is a swing westward which takes in the Schenectady sand plains section. It is located for the main part within the State in the big geologic unit known as the Great Appalachian Valley, characterized by its bedrock of gneiss, sandstones, and schist. The soils owe their origin mainly to glacial action, are variable in their character of sand or clay composition, and are for the most part fertile.

In the southern part of the region, notably on the western bank of the Hudson, long trap ridges covered with forest occur. While extensive belts of forest occur in the rougher sections, probably not more than 40 per cent is in forests.

This region was par excellence a chestnut region, but the importance of this tree in management has entirely been voided by the blight. Passing by the chestnut the region then reverts to an oak region, the only region within the State where these species are to be regarded as of paramount importance. In order of their importance they rank as red oak, white oak, black oak, chestnut oak, and scarlet oak. On bottomland soils, black ash, swamp white oak, and tulip poplar are the most important trees. Basswood, butternut, and black birch, where they occur, are also of importance in this region. Conifers are scarce and are not important in the present forest. Their importance will undoubtedly be increased by economic demands for clear cutting and artificial planting of conifers as a part of the forest management on suitable sites.

On a broad differentiation only three forest types of permanent character, broadly defined and easily distinguished, seem of such importance as to be outlined: (*a*) Upland hardwood, (*b*) hardwood swamp, (*c*) pitch pine.

Upland Hardwood.—This type probably occupies 75 per cent of the forested area within the region, occupying a large range of sites and soils, only being excluded from the swamps and dry sand soils. As already pointed out the oaks are the trees of paramount importance both from a silvicultural and commercial standpoint. Due to its speed of growth and high technical quality red oak seems to be the best species to favor. Chestnut oak, and basswood where found, should also be favored.

No specific systems of management should be laid down. Under certain conditions, mainly economic, high-forest methods should be followed, under others, coppice methods. With the increase of the economic demand for wood material, a considerable portion of the area within this type will be converted to coniferous forest through clear cutting and planting. As such it will probably yield a better financial return than that from the present hardwood forest.

Hardwood Swamp.—This type were better described as hardwood bottomland than hardwood swamp. Tulip poplar, black ash, swamp white oak, soft maple, and occasionally red gum are found. Very little lumber is produced in these swamps, most of the material being of cordwood character only. Rapid growth is the prevailing characteristic except where the water table is too close to the surface layers. Reproduction is almost solely by sprouts.

Pitch Pine.—This type occurs in the northern and northwestern extension of this region on the dry sand soils of the Mohawk and Hudson Sand Plains. It is also found in the dry sandy drumlin soils of Long Island. It is to be pointed out that pitch pine is a distinctly inferior species, both from a commercial and silvicultural standpoint. It is also to be pointed out that these sand soils are favored by white, red, and Scotch pines. Management within this type should seek the replacement of the inferior pitch pine with more valuable species. Due to the invasion of the white pine blister rust it is believed that red pine and Scotch pine should be favored. Management, then, will be mainly a planting proposition. The State acquisition and planting of these soils will be the first definite step toward the solution of the forest problem within this type.

CATSKILL FOREST REGION

This area comprises some 3,000,000 acres of which probably 70 per cent is forested. The region is located entirely on that rough, rugged, upland extension and accentuation of the Appalachian system known as the Catskill Mountains, a system marked by rather broad, open valleys, abrupt slopes, and rounded summits, upon which a heavy forest growth is found. Underlying rocks are principally sandstones and slates from which the surface soils are mainly derived. Glaciation seems to have played a comparatively small part in the development of this region.

As before stated, the region is well forested which clothes the mountains entirely to their summits. Four forest types seem distinct: (*a*) Bottomland, (*b*) oak slope, (*c*) mixed hardwood, (*d*) spruce ridge.

Bottomland.—This type is of minor importance from the forester's point of view because it occupies sites mainly of agricultural value. Consequently these areas will be decreased as agriculture advances. Elms, sycamores, and hemlocks are the main trees found. It is not believed that this type will play any part in management.

Oak Slope.—This type occupies rather deep soils with gentle slopes on southern exposures. Due to this latter fact the soil is apt to be dry. Red oak, white oak, with yellow birch, maple, beech, and basswood are to be found within this type.

Mixed Hardwood.—This is differentiated from the oak slope type on the basis of site and of composition. While it occupies steeper slopes with less depth of soil, it is found on north exposures which are moister and cooler both in the surface and sub-surface layers. In composition the oaks are not found in this type and there is a less restricted variety of hardwoods, including mainly beech, yellow birch, and hard maple, with some basswood and an occasional hemlock.

Spruce Ridge.—Restricted to the mountain tops at high elevations with rocky, thin soils and steep slopes. It partakes very much of the character of the upper spruce slope type of the Adirondacks, being composed mainly of red spruce, balsam, yellow birch, and maple. It is primarily a protection forest and should be so considered and maintained.

In spite of its accessibility to the Delaware and Hudson Valleys the Catskills are but little developed from a forestry point of view. In the southwest and southern sections there is a considerable development of the wood distillation industry. No intentional forest management for this industry has ever been attempted. Sprout reproduction has been successful following clear cutting and, until a higher developed form of utilization is introduced, forest management in this region should seek to improve upon the present system of coppice reproduction.

CONCLUSION

The absolute criterion of any scheme of management is not the *restriction* of the cutting of timber on any lands public or private but in the specification of the removal of that amount of timber which just

balances growth and which leaves the forest in as high a state of productivity as before. While present methods of lumbering have not resulted in forest devastation they have resulted in forest deterioration both in species and amount and soil productivity. Unless this point is properly emphasized the forester is forgetting his duty to the public and the State.

The enterprise of harvesting wood material is attended by financial hazards of severe proportions. The rewards of any business are its profits. So it is with the lumber business. Any imposed restrictions which materially and unfairly increase the hazards of anticipated profits in lumbering are to be deprecated. No system of regulation or control can hope for success which is imposed without the willing consent of the lumberman and worked out with his intelligent co-operation. The success of the future of forestry in America for the next fifty years rests, not upon mandatory regulations, but upon co-operative operations. The results of such co-operation will assure a trifold result: the continuance of a supply of wood necessary for the public welfare, the permanence of a basic industry whose lack of permanence has been and is its worst feature, and the institution of a sustained economic policy of mutual advantage to both the public and the owner.

Silviculture and management are based on empiricism as applied with intelligence to meet local conditions. It has been perfectly obvious that in many cases silvicultural success has been obtained without intention, by operators practicing in total ignorance of the word or its meaning. Even two foresters, unable to agree in theory, may follow two diametrically opposed practices and yet both achieve success in result. Hard and fast instructions to cover a given region or type are to be avoided mainly on the grounds of their rigidity, their common difficulty or interpretation and enforcement. Any scheme of forest management adopted for the State as a whole must recognize the foregoing fact and endeavor by simplicity of precept and elasticity of application, coupled with intelligent interpretation, to achieve a unity of purpose.

The adaptability of any scheme of silviculture on a wide scale rests absolutely on the simplicity of its conceptions. The fundamental conception here is a continued supply of a definite raw material with the accentuation on the word "continued." The achievement of such result can be made by three very simple practices, so simple as to be easily

apprehended by all, namely (*a*) clear-cut and plant; (*b*) clear-cut with sprout reproduction; (*c*) gradual removal of ripe trees on a strict selection basis. If protection be called silviculture a fourth may be added as adequate fire protection.

Increased forest protection is as necessary as increased silviculture. It seems to the writer that too much stress is being placed on patrol and not enough upon the actual root of the evil—the disposal of brush. We have not enough accurate information upon either the results of top lopping or the cost of brush disposal to be dogmatic about it either way. But it would seem from experiments elsewhere that the piling of brush during the swamping operations and winter burning might be quite as cheap as added patrol of privately cut-over lands and much more efficacious in the real solution of the whole fire problem, which is not fire protection but fire prevention.

Finally, any policy of management for the State must be co-ordinated and harmonized with similar schemes in adjoining States. Failure to do this in general or in detail will only lead to endless confusion and lay the foundation of failure of the whole forestry movement as a State and a National issue.

RESULTS OF AN EXPERIMENT IN REPRODUCING HARDWOOD STANDS UNDER THE SHELTERWOOD METHOD [1]

By William D. Durland [2]

In 1906 four sample plots with numerous reproduction plots were laid out on the Maltby tract of the New Haven Water Company, near New Haven, Connecticut, by the U. S. Forest Service, in a stand of mixed hardwoods 60 years of age.

The purpose of the experiment as stated in 1906 was to investigate "reproduction and increased growth after reproduction cuttings."

Two thinnings had been made in the stand previous to the establishment of the plots, in 1902 and 1906 respectively.

The four plots differ in site quality and are typical of important subtypes found within the oak type of southern Connecticut. Plot 324 is Quality I mixed hardwoods containing in 1906 29 per cent chestnut, 52 per cent red, chestnut, black and white oaks, and the balance such hardwoods as ash, tulip, hickory, black birch, and beech.

Plot 325 is a Quality III chestnut oak ridge. In 1906 the composition was 72 per cent chestnut oak, and 25 per cent red, white, and scarlet oaks.

Plot 326 is a poor Quality II mixed oak stand. Black oak formed 47 per cent, red oak 23 per cent, white, chestnut, and scarlet oaks 9 per cent, and hickory and chestnut 21 per cent of the composition in 1906.

Plot 327 is a Quality III mixed oak stand containing in 1906 4 per cent of red oak, 26 per cent white oak, 22 per cent black and scarlet oak, and 12 per cent hickory, chestnut, black birch, and ash.

The plots were remeasured in 1911, 1916, and 1921. In the period from 1906 to 1916 the chestnut blight killed the chestnut. The blight-killed chestnut was removed together with a few small trees of other species. With this exception the plots had no cuttings made in them from 1906 to 1921. In March, 1921, the stand, now 75 years of age,

[1] For further details the manuscript report on the same subject by W. D. Durland filed in the library of the Yale School of Forestry should be consulted.

[2] Contribution No. 20 by the Yale School of Forestry.

on and around the plots was cut clear. In 1922, a year after the clear cuttings, the reproduction plots were remeasured.

TABLE 1.—*Comparative Values for the Four Plots in 1921 Before the Clear Cutting.*

Plot	Site quality	Subtype	Total volume per acre		Basal area per acre, in square feet	Average height dominant trees in feet	Periodic annual growth, 1916-1921		Age
			Cu. ft.	*Bd. ft.*			*Cu. ft.*	*Bd. ft.*	
Plot 324	I	Mixed hardwoods	2,340	7,100	63	81	73	340	75
Plot 325	III	Chestnut oak	1,500	1,100	61	50	42	75	75
Plot 326	II	Mixed oak	2,170	3,600	59	67	121	255	75
Plot 327	III	Mixed oak	1,230	400	55	45	33	50	75

The conclusions drawn from the experiments are summarized below:

1. Hardwood stands on Quality III sites will not produce satisfactory yields of lumber in 75 years. Longer rotations are not likely to show correspondingly better results.

2. Since Quality III sites are unprofitable for the production of hardwood lumber, the question of converting the type to pine plantations should be considered. It is known that white pine in southern Connecticut will on similar sites attain lumber size in less than 75 years.

3. Hardwood stands on site Qualities I and II, even now that chestnut, the fastest growing species, has been exterminated, can produce reasonable yields of lumber in 75 years. The figures of yield given in the table are very conservative since plots 324 and 326 grew 67 years with chestnut as a dominating species, and yet no chestnut appears in the yield figures.

4. The advisability of converting hardwood stands on Quality I and II sites to pine is open to question.

5. Reproduction, both seedling and sprout, was present in 1906, at the time the experiment started, in sufficient quantity (8,000 to 13,000 trees per acre) to fully stock the area. Whether this reproduction came in as a result of the cutting in 1902 and 1906 or whether abundant seedling reproduction should be expected in all hardwood stands by the 60th year, this experiment has not determined.

6. The reproduction present in 1906, when the plots were established, did not increase or greatly change in composition during the period from 1906 to 1921.

7. As a result of the clear cutting in 1921 an increase in the amount of reproduction (principally of sprout origin) in 1922 as compared to 1921 took place.

8. Except in the case of chestnut, the reproduction on the ground in 1922 will accomplish the perpetuation of the sub-types found in 1906 on the different site qualities.

9. Since the greater part of the reproduction originated prior to 1906 under the shelter of the old stand it is evident that the shelterwood method can be successfully employed in regenerating the various sub-types of the oak type represented on the plots.

FORESTRY IN BRAZIL

By Joseph Kircher

U. S. Forest Service

Brazil, which covers an area a little larger than continental United States, has probably the greatest forest wealth of any country in the world. Here are vast tropical forests with great varieties of valuable and very beautiful hardwoods. Here also are such valuable trees as rubber and the cocoanut palms, to say nothing of many other varieties of trees yielding drugs and oils. Farther south in the mountains there are vast pine forests largely inaccessible because of lack of transportation.

The forests of Brazil are said to cover 48 per cent of her area; 20 per cent are pine forests, the rest hardwoods. And yet with all this timber wealth, Brazil is not wholly without her timber famine problem. It is true that for many years she could draw upon these vast areas, still, just like in the United States, her forests are not in all cases in the location where forests products are most needed. In some of these places they have been completely destroyed and a local timber famine is noticeable in a rapid rise in prices.

Though rich in wood, Brazil is almost without coal. The few deposits so far discovered, are in the southern part of the country, far from the more densely populated regions and therefore not readily accessible. The coal is said also to be of poor quality. Furthermore, imported coal from the United States or England is naturally very expensive. This has forced the use of wood as fuel on most of the railroads. Accordingly, vast quantities of wood have been cut along all of the railroads and now the accessible supply is getting scarce. In the State of São Paulo, for instance, the price in the past five years has already risen from 3 milreis [1] (36 cents) to 7 milreis (84 cents) per cubic meter, and it is predicted that within a year or two it will be 10 milreis ($1.20).

There has also been a wholesale burning of forest lands to make way for crops. In their virgin state, the forests will rarely burn because of the presence of much green underbrush and the plentiful rainfall. To

[1] At present rate of exchange 1 milreis equals about 12 cents (normal 32 cents).

clear land, however, the native cuts and piles the brush, then the trees are girdled. When the brush has dried out sufficiently the whole mass is burned wholesale, leaving very little behind. The timber is rarely logged first, since very often there is no market for it, especially if it is any distance from the railroad. At any rate it is easier to let fire do the work than to cut the exceedingly hard timber found in Brazil. In this way thousands of acres of forest have been devastated, many of the lands later having been abandoned as poorly suited to agriculture.

Far-seeing individuals and some of the more progressive railroads have recognized this condition and realize that something must be done. A timber supply for the future must be assured. The railroads, of course, are interested mainly in future supply of ties and fuel wood, for lumber can be secured for many years at reasonable prices from virgin stands.

Through the influence of a few individuals, a start has already been made in both government and private forestry, although it can hardly be said that the forestry movement has yet taken hold of Brazil.

For many years, the progressive State of São Paulo has maintained a forest nursery where experiments are conducted with both native and exotic trees. Curiously enough, in spite of Brazil's great wealth of forest species, the tree today most favored for plantations is the Australian eucalyptus. This tree is so popular because it is said to grow faster than any native species.

Experiments have been going on with eucalyptus for many years, long enough in fact that some of the first plantations have already been cut. Seeds of a large number of species were originally imported from Australia and extensive experiments started. As a result of these studies, the best species have been determined and the growing of eucalyptus has now passed the experimental stage.

Probably the foremost and largest plantations of eucalyptus are those of the Paulista Railway. This company has now demonstrated to its satisfaction that growing eucalyptus is a paying proposition. Accordingly it has started a policy of extending its plantations tremendously and now has about 21,000 acres of eucalyptus plantations. The Leopoldina and other railroads are also growing eucalyptus.

The Forest Service of the State of São Paulo is encouraging the planting of this species by individuals. At the present time it is producing and distributing at a very low cost about 1,200,000 plants per

year. The State of Minas Geraes also has a forest nursery where eucalyptus plants are sold.

The São Paulo Forest Service and the Paulista Railway are also experimenting with plantations of other species, most of them native. Of these, the most promising is the Paraná pine (*Araucaria brasiliensis*), which makes a rapid growth, and it is believed could be cut for lumber in about 25 years. At that age trees should be about 16 inches d.b.h. and 50 to 60 feet high.

Plantations at the Horto Florestal at São Paulo have already given the following results to the director who describes the cutting.[2]

A thinning of Paraná pine at 18 years of age gave the following results:

Average height of trees 12 meters (39 feet).
Diameter of trees cut 10 to 35 c.m. (4 inches to 14 inches).
Trees had been planted 3.50 meters apart (11½ feet).

As the diameters were small, the trees were sold as wood, each group of four trees giving a cubic meter of wood. This was sold at 8 milreis per cubic meter (about $1.00), giving 2 milreis (25 cents) per tree. As in each hectare, there were cut about 600 trees, the cutting brought 1,200 milreis per hectare. Four hundred trees were left (243 trees cut per acre, bringing 486 milreis ($60.75). Trees left 162.

This station has also reforested a considerable area with Paraná pine, the largest of the plantations containing 120,000 trees. Pine is also being grown by at least one paper company which expects to cut the stand for pulp at 20 years.

So far, however, the Federal Government has done little or no forestry work. A nursery was established at Rio de Janeiro some years ago, but due to political interference its work has now practically ceased. There are several botanists, though, studying the trees of Brazil and some work on wood identification is going on. In December, 1921, a comprehensive forest law was passed by the National Congress. It provided for a Forestry Department which was to study all phases of forestry and to acquire forest lands. Up to the present, however, this bureau has not been organized.

Forestry in Brazil today, therefore, is practically confined to the study and practice of reforestation, and even this is largely done only in the State of São Paulo. As far as the writer is aware no attempt

[2] Dr. Adalberto de Queiroz Telles in "Apoutamentos de Silvicultura"—São Paulo, 1922.

has yet been made to practice forestry in any of the virgin stands of the country. Forest devastation has not yet reached the stage where it is a menace to the prosperity of the country, and it would seem that Brazil now has an excellent chance to preserve her most valuable resource instead of later on trying to replace it. But whether the country will heed the cry of those few individuals who realize the present need for forest conservation, or will devastate the greater part of her forests as the United States and other countries have done, and then take remedial measures, time alone will tell.

CLASSIFICATION OF FOREST SCHOOL GRADUATES AS AN INDEX OF THE PROGRESS OF FORESTRY

By E. A. Ziegler

Director, Pennsylvania State Forest Academy

Is the practice of forestry moving satisfactorily in this country? The considerable call for Government pressure on private forest owners is evidence that it is not—at least in privately owned forests. As an aid to a better understanding of the movement of the various currents in forestry practice it occurred to the writer to try a rough analysis of the employment of forest school graduates as the best index. To this end a request for a classification of the professions of forestry graduates was mailed to the majority of the older forest schools of the country. A complete canvass was not intended and schools not listed are not left out because of any discrimination. The group given is believed to represent a very considerable "sample plot" of the entire field.

A note of warning must be appended against exact comparisons between single schools, as some schools included forestry degree men only, while others included men also who had taken a partial course.

The percentages of the entire group in the different lines of work do reflect very well what was sought in the classification and a general consistency is apparent throughout Table 1.

The figures on the Universities of Michigan and Washington were taken from their directories. Where no forestry or lumbering activity was specified the men were classified as "other callings." It should also be noted that "city foresters" were included in "other callings." The tabulations received from the other schools in some cases were slightly re-grouped to make a general tabulation and summary possible. Because of lack of uniformity in individual school tabulations greater detail had to be omitted to secure the summarized table (Table 1).

Several other details of the following tabulation should be recorded. A few men who went into "rubber plantation" work were included in "private forestry." Where men were explicitly given as with the Government in products laboratory work they were included under the

TABLE 1.—*Activities of Men Who Attended Some Forest Schools, as Bearing on the Forestry Progress of the Country.*

Name of school	Number of Men in—					
	Government forestry	Private forestry	Teaching and graduate work	Lumbering and products	Other "Callings"	Total
University of California.....	10	....	....	16	6	32
Cornell University.....	21	16	9	12	46	104
University of Michigan.....	78	9	18	37	181	323
University of Minnesota.....	38	....	6	33	40	117
N. Y. State College of Forestry.	[1]37	8	14	25	90	174
Oregon Agricultural College..	19	0	2	35	26	82
Pennsylvania State College....	37	1	12	53	58	161
Penna. State Forest Academy.	54	6	7	6	51	124
University of Toronto.....	39	1	2	6	20	68
University of Washington....	31	4	9	100	96	240
Yale University.....	135	49	58	61	225	528
Total.....	499	94	137	384	839	1,953
Per cent.....	25	5	7	20	43	100

[1] New York State College of Forestry reported 45 men engaged in activities concerned with forest production—that is, in government and private forestry. The above division as 37 and 8 is therefore arbitrary and was so arranged as to have practically no effect on the percentages below.

"products" head. It is also surmised that one or two schools included under "teachers" meant teaching other subjects than forestry. These small difficulties would not change the general results to any great extent.

DISCUSSION OF THE TABULATION

Allowing for the "city foresters" included in "other callings" it is clear that about 60 per cent of the forest school graduates are engaged in work for which their training furnished at least a broad foundation. This proportion is in line with the experience of professional schools in general.

When, however, the distribution of the 57 to 60 per cent of the graduates who remain in forestry or related work is examined, the weaknesses of the forestry movement are quickly revealed. It must be kept in mind that the central force in this forestry movement is primarily the maintenance of the wood and timber supply of the

country, and secondarily the indirect benefits from the maintenance of the forest cover. In other words, in the forestry movement forestry is the thing. And by "forestry" is meant specifically forest production—the maintenance of a forest cover on forest land, which will meet our needs in direct and indirect forest benefits.

The important fact reflected in the percentages above is that the proportion of men connected with actual forest production (timber growing) is only 30 per cent. If the Government group were carefully analyzed and publicity men and others not very closely connected with the handling of forest land were separately classified, as well as those of the "consulting foresters" mainly engaged in estimates and valuation work for timber purchasers among private foresters, this percentage of foresters growing timber would fall to probably 25 per cent.

When it is noticed that the Government, which controls only one-third of the forest land, is employing five-sixths of the foresters engaged in forestry work proper, private forestry in the United States may be said to be almost non-existant.

This condition of affairs can be said to indicate as a part remedy, private forest practice under mandate by the Government and we have an effort on in that direction now. This should be speeded up. But the writer believes that *Government ownership* can be greatly extended with less effort and better results than compulsory private forestry. The history of the movement and the results thus far bear out the belief. The view that a great extension of Government ownership is possible is supported by the commendable activity of the Northwest Coast States in adopting the policy of acquiring cut-over forest lands which are clearly absolute forest soil. As long as high quality virgin forest stumpage is thrown on the market (even by the Government) at $2 to $4, which is far below the cost of production, private forestry will languish even under a compulsory law.

Forest stumpage must be got in strong hands if it is to reach a "cost of growing" basis. Private ownership—much scattered—will not furnish this. As good an example as need be offered in proof of this statement may be found in the farm product situation at this very moment. Farm products are claimed to be selling below the cost of production. Each farmer competes with the other. The farmer, the woods worker, and every other group with individual competition

suffers as compared to anthracite coal producers (owners and miners), the shoe manufacturers and workers, the railroad groups, all of whom secure a relatively larger share of the national income than the farmer or the forest worker.

Competition among private forest owners in Pennsylvania is so keen in the sale of the last vestige of timber on their lands (stave wood for slack barrels and kegs) that it requires careful operating to net 30 cents per cord stumpage four miles from the railroad. Competition among private forest owners will not permit of wood prices that will make forestry remunerative until owners can be generally impressed with the real cost of growing. Prices of mine timbers are so near the labor cost of removing them from the land, plus an excessive transportion cost, that stumpage owners 150 miles and over from the mines in Pennsylvania cannot secure any stumpage return.

Foresters may object that long rotations will remove this excessive competition in short rotation products. Private forest owners cannot compete with *present* virgin forest stumpage prices (including those of the U. S. Forest Service) except very locally. To say that future prices may be higher may be stating the truth, but the general practice of forestry by private owners will come only as fast as *present prices* show a profit, and in most instances that is a number of years in the future.

The weakness in private forestry shown in the above tabulation has therefore an economic basis. This weakness must be removed by economic changes. Mere political dictum (compulsory private forestry) will not meet the situation. It may become a means to force the lands into the hands of the Government. This would be a desirable result.

The writer has long been convinced that an adequate forest policy in America must be based on *Government forest ownership of from one-half to three-fourths of the forest area,* if such a policy is to be a factor in warding off timber scarcity of serious extent. Nothing short of such a scarcity in actual operation can bring the competitive prices of stumpage generally to such a point where private forest owners will practice forestry.

Government ownership of forest land in Pennsylvania should cover 7 million acres out of the State's 13 million. The National Government must extend its ownership in the East but the States both east and west must be persuaded to back the policy in earnest (like some of them

are backing the good roads problem) with bond issues, if need be, of tens of millions. The forestry problem is equally as vital to the welfare and happiness of the people as the roads problem.

That it has been perfectly natural for the forestry graduate to step past the field of private forestry (made unremunerative by excessive competition) into Government forestry, and now that that field ceases to grow rapidly, into products, and arboriculture ("city forestry"), is evident from the somewhat parallel case of the graduates from agricultural colleges. One would suppose that the majority of agriculture graduates would engage in *agricultural production.* The following figures show however that they, like the forestry graduates, have stepped past the larger field of production (practical farming) into teaching and other agricultural activities (research, agricultural products, etc.).

Name of school	Percentage of Graduates in—				Total number reporting
	Practical farming	Teaching	Related agricultural pursuits	Non-agricultural pursuits	
University of California.....	30	49	49	21	[1]481
N. Y. State College Agriculture (Cornell).....	28	19	34	19	427
Pennsylvania State College....	29	18	26	27	510
University of Wisconsin.....	19	17	25	39	850
Mean.....	27	47	47	26	2,268

[1] 831 graduates. Answers received from 481.

The similarity in the proportion of graduates in forestry and agriculture engaged in growing forest and agricultural crops (production) is most striking. The general weak market (due to excessive competition above noted) for the products of both make what should be the main fields, less attractive financially for college trained men than other related activities.

For a further study a number of engineering schools were asked for a classification of their graduates according to employment. Only two schools asked had a classification available.

Although the number of engineering schools reporting is hardly adequate for the best average, the conclusion seems sustained that over twice the number of men remain in the main branch of the profession in the case of engineers as compared with forestry and agriculture.

School	Actual engineers	Engineering executive	Non-engineering	Number of men
	Per cent	*Per cent*	*Per cent*	
University of Pittsburgh...	63	17	20	[a]1,296
University of Wisconsin...	51	12	37	

[a] 10 years' graduates.

The possible freer interpretation of the term "engineer" cannot account for the large difference.

SUMMARY

The writer wishes to emphasize that he is not censuring either the forest schools or their graduates for the apparent discrimination against the field of forest production (timber growing). He merely is trying to show a condition. The following statements appear justified in view of the above discussion.

(1) Less than one-third of our trained foresters are engaged in *timber growing*. This economic condition has a parallel in agriculture. Our forests in price competition are still "mines" even though many of them are "worked-out mines."

(2) Private forestry involving the proper handling of 70 per cent of our forest land is practically non-existent. This is an economic condition largely, as present competitive stumpage prices are not on a forestry basis, and capital is not available for business based largely on future price predictions, however inevitable the upward movement appears to the forester and economist.

(3) The bulk of the foresters in timber growing are in the Government service and are engaged with the growing of timber on less than one-third of our timber land. This holds in spite of the fact that Government employment of foresters has greatly fallen off in the United States in the last few years, and because the private employment has not increased proportionately. In other words, the forestry we have today is mainly Government forestry.

(4) While private forestry should be urged and pushed forward by every means possible (even made compulsory), if the coming timber shortage is to be even mitigated immediate forestry progress is necessary. Rapid extension of *Government forestry* is the only solution.

More foresters must be put to work on timber production. Timber lands must be in strong hands. Cut-throat competitive stumpage prices should be eliminated on the one hand, and abnormal speculative prices (which will result later) held in check on the other. The National Government should extend its holdings on interstate watersheds. But the greatest extension of Government ownership must be by the individual States. The policy of acquiring cut-over lands valuable for timber growing only, being laid down by the Pacific States, where excuse for delay is the greatest, is a most hopeful sign. States must face the problem on an adequate scale with considerable bond issues. It is the finest *investment* of our common funds that can be made.

Back of the grim timber production (with the maintenance of industry) argument, lie the potent arguments of low interest rates as carrying charges (Government bonds), of public water supply (domestic, power, and navigation); and among the many others, the public use of the forest for hunting, fishing, and recreation generally. This last use is growing in popularity by leaps and bounds, and in the long run will alone make imperative Government ownership and free public use of our forests.

DEVELOPMENT OF (FRENCH) MANAGEMENT METHODS FROM 1912 TO 1922

By A. Schaeffer

Conservateur des Eaux et Forêts, at Vesoul, France

(Translated by T. S. Woolsey, Jr.)

The period under discussion has been filled almost entirely by the Great War, during which time forestry officers have had other problems to consider than that of the development of methods of management. It may, however, be said in a general way, that during these last years the need of transforming the coppices into high-forests has shown itself to be of increasing importance. The war has been a great consumer of wood, of building timber especially, and as early as 1916 an army forester, Commandant de Lesseux, pointed out the enormous consumption of ligneous material called for by the construction and upkeep of the trenches. One single infantry shelter required from 10 to 20 stéres of cordwood (3 to 6 cords); the installation of one piece of artillery consumed from 40 to 50 cubic meters (10 to 12½ M feet b.m.).

When the American Army came into the line for the great offensive the consumption increased again, and in enormous proportions; barracks were needed, railway ties, planks, bridges to cross the rivers of the devastated zone, etc.

We can but reproduce here the conclusions of M. de Lesseux's study:

1st. The forests treated as "high-forests," whether conifer or broad-leaved, yielded easily and rapidly timber of as large dimensions as they had ever done. The abundance of stands of medium age, pole stands and young high forest, permitted the marking of heavy thinnings with a big yield of timber, without compromising the future.

2d. The forests treated as coppice-under-standards have shown themselves entirely unfit for furnishing wood other than fascines, hurdles, "gabions," and charcoal material; they cannot yield timber, and a large quantity of first and second term standards cannot be removed without seriously endangering the future of the forest.

Translator's Note.—M. Schaeffer spent a decade or more making working plans for the fir forests in Savoie which required an increased growing stock because they had been badly overcut and mismanaged by Italy. He is recognized as the chief management expert in France.

The necessity of previously felling the coppice in order to get at the reserves marked for cutting is always inconvenient, and in some cases a radical obstacle to their removal. It is unfortunate that the forester, confronted by great forests of several thousands of hectares (1 hectare = 2½ acres) treated as coppice-under-standards,[1] finds himself unable to get out even a few hundred cubic meters of timber; he has no reply when other branches of the service point out the enormous disproportion between the area of the forest and the yield in timber. We must, now, admit the fact that the cultivation of coppice-under-standards has been able to give only extremely indifferent results; it has given what it could, that is the branches, but that is not the rôle of State forests; it will be critically judged in the end, and should give place wherever possible to the establishment of high forests.

The conclusions reached during the war only back up the opinions already expressed before 1914.

In 1913 Inspector-General Lafosse wrote: "In many regions, especially in the East, coppice-under-standards are no longer suitable. The forests under this method of treatment are in full decadence. The small-sized wood which they chiefly produce is no longer of value, because of the changes in metallurgy and the modifications introduced in methods of heating, etc. . . . ."

M. Huffel had already made analogous declarations. Everyone, therefore, is agreed that the conversion into high-forest is imperative, but the standard method of conversion requires a long time and imposes very heavy sacrifices which it is not always possible to ask of the communities and individuals who own the greater part of the forests treated as coppice.

The question, then, was to find a method which would permit us to intensify the production of timber without the long delay required in the formation of a regular high-forest. A type of stand has therefore been suggested intermediate between the coppice and the high forest, that is to say, something like a selection broadleaf high forest (*futaie jardinee feuillue*).

We have long had coppices very rich in standards, where the (timber) volume reaches 200 cubic meters per hectare (20 M feet b.m. per acre). Felling this coppice only every 25 or 30 years, it became necessary to realize at each cutting 50 or 60 per cent of this

[1] A case in point is the State forest of Clairvaux, containing 4,211 hectares.

material, which offers serious disadvantages. The new methods have a tendency to cut more frequently, forming a very large reserve (in standards) so as to increase the production of timber and to gradually substitute reproduction by seed to regeneration by sprouts.

If a forest is divided into 30 annual cutting areas, two cuttings are made (each year) instead of one, so that the same point is cut over every 15 years, substituting for the coppice-cutting what may be called improvement-cutting or selection thinning. The technique of the operation would be as follows: Cut the ripe or defective trees, thin the groups, make sure of the regeneration and the development of the most valuable species. But a limit should be fixed to the amount removed and for that an answer must be given to the following question: What per cent of the volume of the principal trees of the stand, 3d and 4th rotation standards for example (*arbres constitués modernes et anciens, par example*), may be realized in a cutting, with the certainty of finding the original quantity at the next felling? If we call V the volume before the cutting, x the fraction to be realized, t the rate of increase, n the number of years in the period under consideration, the following equation may be established:

$$(V - Vx)\ (1+t)^n = V$$

It is the same formula as that which is used to fix the (previous) deduction that may be made from a sum of money placed at compound interest, given the condition that the original capital shall be reconstituted at the end of a certain number of years.

In simplifying the equation, V disappears, and there remains:

$$(1-x)\ (1+t)^n = 1$$

$$1 - x = \frac{1}{(1+t)^n}$$

$$\text{therefore}\quad x = 1 - \frac{1}{(1+t)^n}$$

If, as ordinarily happens, the 2d rotation standards or the average-sized trees preponderate, t may be allowed to have a value of 3 per cent or 0.03, and, in the case of a periodicity of 15 years:

$$\frac{1}{1+t)^n} \text{ becomes } \frac{1}{1.03^{15}} = 0.64$$

From which it follows that $x = 1 - 0.64 = 0.36$, that is, that by realizing 36 per cent of the volume the stand may be expected to reconstitute itself in 15 years.

When, on the other hand, the new standards (báliveaux) are not entered or included in the estimate of the original volume, and when a

certain proportion would have reached, in 15 years, dimensions of inventory size, the stock would have increased; there would be not merely reconstitution but enrichment.

If we assume in the hypothesis that the big trees predominate, it will be wise to reduce the rate to 2 per cent.

$$x \text{ then becomes } 1 - 0.74 = 26 \text{ per cent.}$$

The rate may also be determined by the aid of Pressler's borer and the tables which accompany it; if these tables show that the rate of increase varies between 2 and 3 per cent, the rate of realization should be made to vary between 26 and 36 per cent, that is, approximately, between a quarter and a third of the growing stock.

We may also consider a more rapid enrichment and endeavor to obtain in 15 years a stock for example one-fifth greater than the initial volume.

$$\text{The problem is: } (V - Vx)\ (1+t)^n = V + \frac{V}{5}$$

The value of x is, in this case, 0.27 for $t = 3$ per cent.

Let us take a concrete example, and choose one of those magnificent coppice-under-standards containing before felling 200 cubic meters of 3 and 4 rotation standards. Let us assume that we cut 25 per cent of the volume, say 50 cubic meters, then there will remain 150.

In 15 years these 150 cubic meters, at the rate of 3 per cent, will be:

$$150 \times 1.03^{15} = 234 \text{ cubic meters,}$$

say 250 cubic meters, adding the volume of the young growth, which have become inventoried trees. That is already a very creditable high-forest.

Even though we should exploit again in 15 years only a quarter of the growing stock, we should realize 62 cubic meters instead of 50, and should have reached the ideal of silviculture; growth equal to the income and the capital.

These few considerations show the importance presented by the idea of the rate of realization: it is a guide, a regulator, a check. It is that which (if the exploitation exceeds 36 per cent[2] for example) warns the operator that he is on the wrong track and raises before him the specter of impoverishment.

The danger of area fellings, whether it is a question of coppice-

[2] Note, in passing, that in a fir-plantation, the cultural interest is opposed to anything beyond 25 per cent. Which comes to this, that for the conifers the period of 15 years would be too long.

under-standards, selection forests, or thinnings, is the absence of a normal rule. *Left to his own inspiration, the operator risks committing gross errors, if he does not fix in advance a limit not to be exceeded.* It goes without saying that the application of these considerations implies stock taking before marking the standards; for that matter, this operation has long been recognized as indispensable, if one is to proceed intelligently.

A certain number of communal forests are already under treatment by these new methods (selection broadleaf high forest or open high forest) which give entire satisfaction. Their advantages are the following, according to M. Huffel:

"The frequent return of the felling to the same point, which is an essential feature of the open high forest, insures the life of the seedlings, thanks to their periodic freeing. This frequent return makes it possible to leave, even after the felling, only small intervals between the big trees. The volume of the trees can therefore occupy a much greater part of the ground than in a coppice-under-standards without its future volume being endangered. The yield of timber will consequently be increased.

"The trees, less separated from each other, would have longer boles, whence added increase in timber production. The waste of all sorts would be utilized at the opportune moment, the cutting is less severe, pruning becomes unnecessary, etc. . . ."

When the coppice-under-standards are situated at more than 400 meters (1,300 feet) above sea-level, the general tendency is to plant them in conifers, always with the object of increasing the production of timber. Where in truth the deciduous trees in the most favorable stations yield with difficulty only 3 or 4 cubic meters of saw timber to the hectare (300 to 400 feet b.m. per acre), the fir gives ordinarily 6, 8, or 10 (600, 800, or 1,000 feet b.m. per acre per year).

The Douglas fir, which is in high favor just now, will probably given even greater returns, although at low altitudes it has not resisted the last year's drought, especially in the Sologne. But there is reason to hope that in the higher altitudes our own fir will find in its American genus a valuable auxiliary to remedy the scarcity of saw-timber, just as the French Poilu found in his comrade, the Sammy, a powerful aid in driving out the Boche.

REVIEWS

Some Aspects of the Use of the Annual Rings of Trees in Climatic Study. By Dr. A. E. Douglass. Scientific Monthly, XV, 1, 1922.

What forester has not paused to meditate upon the story revealed in the rings of fallen pine? We pride ourselves upon our ability to point out the periods of famine and plenty in the lives of these veterans of the forest. Out in Arizona lives an astronomer, Dr. A. E. Douglass of the University of Arizona, who has read even deeper into the hearts of the trees than have their appointed guardians and friends, the foresters. For many years Dr. Douglass has been an ardent student of tree rings in their relation to astronomical and climatic phenomena. Some of his recent findings were announced in his presidential address before the Southwestern Division of the American Association for the Advancement of Science.

Douglass has worked on the theory that variations in the width of tree rings are determined by climatic conditions, and that the latter, in turn, are closely related to solar activity. In regions of meager rainfall, annual growth agrees closely with the precipitation curve. Thus it happens that the yellow pines of northern Arizona have provided excellent material for this study. In regions of optimum moisture and temperature, annual variations in growth are slight. Ample consideration seems to have been given to such factors as density of stocking, variations in site and double or missing rings.

Two or three rings are sometimes formed in a single season in yellow pine, although such occurrences are rare. Four or five cases were found in 67 trees near Prescott, Arizona; none occurred in nearly 200 yellow pines examined near Flagstaff, and none in nearly 100 yellow pines and spruces from northwestern New Mexico. The sequoias of California, Douglas firs from Oregon, hemlocks from Vermont and Scotch pines from northern Europe show no signs of doubling. It appears to be common in Arizona cypress and junipers. Missing rings are usually not absent in the entire circumference of the tree. Douglass does not rely entirely on skill in tracing out double or missing rings. The most reliable check on the yearly identity of a ring is obtained by means of a system of "cross-identification" which is based upon the similar sequence of wide and narrow rings in dif-

ferent trees. Trees from widely separated regions have been found to agree very closely in this respect over long periods. Deficient years usually make a narrow ring in sharp contrast to those on either side. Wide rings, on the other hand, usually come in groups, and therefore have less individuality than narrow rings. The narrow ring corresponding to a lean year is usually represented in over 90 per cent of the trees of a stand, and occurs over a wide geographic range.

A number of instruments have been devised to meet the requirements of this study. Among these is one which measures the width of each ring and records it on co-ordinate paper on a scale magnified 20, 40, or 100 times. Another apparatus, known as the "Periodograph," is used for detecting cycles or periods in a plotted curve. The Swedish increment borer has been found very useful. It has been supplemented by a larger borer which extracts a core 1 inch in diameter and 2 feet in length.

The use of tree rings as an index of climate in periods antedating instrumental records has great possibilities. It must be borne in mind, however, that the width of rings may be determined by any one of several climatic factors or a combination of factors. Within any region it is usually the limiting factor which is most strongly reflected. In the Southwest this is rainfall. Douglass places the accuracy of pine trees as a rain gauge in northern Arizona at 85 per cent; but even with this high degree of sensitiveness to rainfall there appears to be a well defined response to temperature. Trunks of prehistoric pines recently excavated near Flagstaff at a depth of 16 feet below the present ground surface point to a much heavier rainfall in prehistoric ages than in comparatively modern times.

Analyses of tree rings over long periods have revealed a periodicity which corresponds not only with available records of rainfall but also with records of sunspots. The most pronounced cycle is one of 11 years. There are also double and triple values of this cycle which have operated in Arizona and in northern Europe for hundreds of years. A 100-year cycle is prominent throughout the 3,000 years of sequoia record and in the 500 years of yellow pine record. There are also other periods than multiples of the sunspot period, and different centuries are characterized by different combinations of climatic cycles.

The economic value of this study of tree rings and climate is to be found in the possibility of long-range weather forecasting. If rainfall were found to vary consistently with the eleven-year sunspot

cycle, a knowledge of this relationship would revolutionize agriculture. Its application to forestry, particularly in fire control and in the timing of planting and other silvicultural operations, is obvious. Unfortunately the 11-year cycle is not a smooth or even a gently undulating curve. The irregularities are so great and so numerous that the general trend is often difficult to perceive. This is attributed in part to the fact, as previously pointed out, that a number of cycles are in operation. Moreover, the effect of sunspots and other cosmic influences may be partially obscured by local influences, particularly in mountain regions. Thus it may happen that in a year when the rainfall of the country as a whole may be abnormally high, it may be abnormally low in a specific locality, or vice versa. More must be learned about climatic cycles before they can be used for predictions applying to a specific year in a specific locality. Enough is already known, however, to form a fair basis for predictions covering periods of about 5 years; and what is perhaps more important, the record of tree rings in past centuries tells us what abnormal conditions the future has in store.

G. A.

An Investigation Into the Relation between Height Growth of Trees and Meteorological Conditions. By W. E. Hiley and Norman Cunliffe. Oxford Forestry Memoirs, No. 1, 1922.

The authors criticize the investigations of Douglass in which the width of annual rings on the stump is correlated with climatic conditions, on the grounds that annual rings are sometimes entirely omitted at the base of the tree, and that the width of a ring is a doubtful index of volume production for the year in question. Douglass, however, appears to have overcome the first of these objections by a system of cross-identification by means of which the absence of certain rings or the presence of double rings can be detected. Height growth is regarded by the authors as a more reliable index than is diameter growth, because height growth is an excellent indicator of site quality, and because it is influenced less than is diameter growth by density of stocking.

The investigation was made mainly in thrifty young plantations of Sitka spruce, European larch, and Corsican pine near Oxford, England. A few specimens of Douglas fir, arborvitæ (*Thuya plicata*), western yellow pine, and beech were also measured. Current height

growth was measured every few days during the summers of 1920 and 1921. A few observations in Corsican pine were made by measuring the distance between whorls over a period of 15 years.

In all of the species the maximum height growth occurred in the foresummer. It generally ceased by the middle of July, though in a few individuals it continued into August. *Thuya plicata* maintained slow growth through the autumn months.

To test the effect of decreasing the water supply, two methods of treatment were applied. In one, the top inch of soil was removed, thus hastening evaporation, removing humus, and cutting superficial roots. In the other treatment, the stems were cut half in two in order to decrease their capacity for conducting water. Removing the surface layer of soil caused a reduction in the 1921 increment by 19 per cent in Sitka spruce, 17 per cent in larch, and 13 per cent in Corsican pine. Cutting half way through the stem improved the growth of Sitka spruce and larch, but reduced the growth of Corsican pine by 24 per cent. Evidently the capacity of the stem for conducting water was not a limiting factor in the spruce and larch.

Mean daily height accretion is correlated graphically with current temperature, precipitation, sunshine and wind movement. With the exception of larch, the current growth seems to rise and fall with temperature. There is, however, no direct relation between actual temperature and actual growth. Maximum temperatures were found to give a higher degree of correlation than mean temperatures. The growth rate of Sitka spruce and Corsican pine doubles with an increase of 10.9° F. in the maximum and 9.1° F. in the mean shade temperature.

Total annual height growth of Corsican pine, as determined by measuring the distance between whorls of branches, is related to the April-June precipitation more closely than to other factors. This finding agrees with that of an investigation by the reviewer [1] which established a close correlation between April-May precipitation and height growth of *Pinus ponderosa scopulorum* in Arizona. The failure of Hiley and Cunliffe to find a relation between current height growth and current precipitation may be explained by the fact that current precipitation is not a good indicator of soil moisture. For the purpose of their study, a direct determination of soil moisture at intervals of about five days would probably have served better than daily precipitation records. Moreover, it is quite possible, as pointed out by the

[1] Pearson, G. A. The Relation between Spring Precipitation and Height Growth of Western Yellow Pine Saplings in Arizona. Journal of Forestry, October, 1918.

authors, that under certain conditions moisture may not be a limiting factor.

G. A. P.

The Ames Forester, 1922. Published annually by the Forestry Club of the Iowa State College, Ames, Iowa.

"Twenty years ago," writes Dr. Hugh P. Baker in his paper on "Forestry—Yesterday, Today, and Tomorrow," which introduces the current Ames Forester, "forestry was deemed a sentimental development, and practical business men laughed at the idea that it might be needed within 50 years. . . . Today . . . foresters are holding important positions with industrial organizations, trade associations, and large manufacturing organizations. In the old days . . . we leaned too heavily on European practice, and Schlich's Manual was about the only forestry literature. (Today) research must go hand in hand with the application of forestry in this country. Without research and without strong schools, there will be a gradual weakening of effort that will eventually end in disaster. . . . The forest schools have meant everything in the development of forestry in this country, and the standing of the profession is due to the insistence of the colleges upon high standards of training."

Dr. Baker's paper is the first of a varied assortment of technical and descriptive articles and incidental pieces, mostly the work of the Ames forestry students, graduates, and faculty, past and present. The subjects range from serious and instructive to burlesque, and the impression is somehow conveyed that they were prepared especially for the edification of the undergraduate mind.

Among the instructive papers is Dr. L. H. Pammel's "Some Notes on Trees of the Sierras," a series of brief descriptions of botanical characteristics, size, age, and distribution of Sierra trees, with special reference to the bigtree. In a paper on lumbering in "The Calcasieu Pine District of Louisiana," George B. Bartman describes the logging and related industries dependent upon the longleaf pine in this region, and tells how "the tottering throne of King *Pinus palustris*" is gradually being upset. W. P. Harley talks technically of "A Logging Operation on the Jicarilla Apache Reservation." "Recreation on the National Forests in the Lake States" is entertainingly handled by R. G. Schreck, Supervisor of the Michigan National Forest. Wolverine foresters will be saddened to learn that the Minnesota National Forest has a

decided "edge" upon the Michigan National Forest as to scenery, fish and game, lakes, and in fact practically everything except accessibility by automobile.

Those who think of Iowa as so totally agricultural that it is not hospitable to forestry will be surprised to learn from Prof. G. B. MacDonald's paper on "Forestry and the Iowa Farmer" that agriculture has tried to go too far in places, with disastrous results that have necessitated a change of doctors. In one locality the Forestry Section of the Iowa Experiment Station is undertaking a reforestation project to save some denuded land from complete destruction. The Iowa farmer shares the kind of myopia, common to the genus, which cannot, or will not, but at any rate does not recognize a difference in kind between crop lands and forest lands. An Extension Service in forestry is striving to correct this and other failings. Demonstration planting, utilization of waste corners and poorer soils of the farm, creosoting of fence posts, and marketing of forest products are the principal current activities in forestry in Iowa.

"The Tie Problem and a National Forestry Program" is the subject of a paper by T. R. Truax, of the Forest Products Laboratory, at Madison, Wis. To meet the requirements of the tie-producing industry ,a national forestry program must provide (1) for a future timber supply by reforestation and protection, and (2) for conserving the present timber supply and securing the maximum service of ties. Statistics of the duration, rate of replacement, and annual consumption of ties are given, and the field of research toward securing the maximum service of ties is outlined. One statement is of especial interest: "Unless continued improvement in the preparation and use of wooden ties is maintained, substitute ties may be expected to come into more general use, and to a constantly increasing extent occupy the field now held almost exclusively by wooden ties."

The "Preservation of Eastern White Cedar Poles," by A. S. Henry, Engineer, Northwestern Bell Telephone Company, discusses briefly the factors of injury to poles and the four methods that have been used for the application of dead oil of coal tar, namely, the brush, submersion, butt, and perforation treatments.

In somewhat less technical vein, Prof. D. S. Jeffers writes alluringly of "The Forest Service—An Opportunity," and E. M. Davis, under the title "When is a Forester Not a Forester?" narrates the adventures of four foresters in the Thomas A. Edison plant, and concludes that "a forester can do anything if he wants to."

Limited space will permit only a mention of several very interesting papers. One of these is W. M. Ling's address on "China, an Objective Lesson in Forestry." Apparently, America's lavish "use" of her resources is a matter of wonder to the Celestial mind. "Recent Experiments with the Salting of Range Live Stock," by R. L. Hensel, Kansas State College, is another valuable contribution. A narrative which fairly oozes calamity and dearly bought experience, under the title of "Trials, Troubles, and Tribulations of a Summer on Grazing Reconnaissance," is contributed by Grazing Assistant R. D. Morris. Something makes one think there is another side to the story. Could any trip be so consistently dolorous?

Annals of summer school field trips of Ames foresters are introduced by C. W. Mastin and F. B. Trenk, and by way of conclusion the early history of Paul Bunyan, from the Creation to the Fall of the Roman Empire, is convincingly and impressively treated by Prof. G. C. Morbeck.

The Ames Forester of 1922 is a good type of the modern forest school publication which aspires to something beside class annals and small talk. The possibilities lying in the development of such publications are great. While the "standard of training" mentioned by Dr. Baker cannot, of course, be adequately measured by what the forest school publishes—certainly not by productions which represent to a degree the lighter vein of college life—still the attributes which determine the professional standing of a department of forestry should be reflected to some extent in its periodical literature. The forest school annual of the present day, with its bias toward humor, poetry, and local color, has not yet, as a rule, risen to the heights of technical value and authority which we may, without too great a strain upon the imagination, expect it to reach. Its serious articles still seem to be written primarily for an undergraduate audience and to lack extensive currency thereby. The fact that contributions of real merit are less rare in such publications than they used to be is a hopeful sign. Some schools of forestry are already well advanced in their own series of technical bulletins, published by the faculty. May we not look forward to the time when the forest school annual, drawing upon a much larger and more varied field of experience, is recognized as an appropriate medium for the publication of valuable miscellanea on forestry, not only by faculty members but by graduates and students as well?

E. H. F.

Control of the White Pine Weevil by Forest Management. By H. B. Peirson, State Forest Entomologist of Maine. Bull. No. 5, Harvard Forest, 1922.

Much has been written concerning the white pine weevil, but all suggestions for dealing with this serious enemy to white pine reproduction have been applicable only to nurseries or small planations. Mr. Peirson has made a very thorough study of this insect in the various types in which white pine occurs and has presented practical suggestions for its control under forest conditions. He has shown that rapidity of growth, density of stand and presence of hardwoods are the chief factors tending to reduce weevil injury. There has long been a need for the thorough investigation of this problem from the standpoint of forest management and it is gratifying to know that one of the serious objections to encouraging this valuable tree can be overcome. The life history of the weevil and artificial means of control applicable to small areas are discussed.

Dr. Hopkins has broadly emphasized the possibilities of forest insect control by forest management. There is a decided need for the detailed investigation of many of these insects from this standpoint and the present paper can well serve as an example for such studies.

F. C. C.

History of Forest Development on an Undrained Sand Plain in the Adirondacks. By W. L. Bray. New York State College of Forestry, Technical Publication No. 13, Vol. 21, No. 2, 1921.

Bray explains the underlying causes of present differences in vegetation on the extensive sand plains of northern New York State, and at the same time shows the relation of the associations to each other. From a detailed study of the Grasse River Bog and adjacent sand plain and marsh he draws conclusions which appear applicable to sand plains and bogs elsewhere.

The sand plains are a result of glacial action; they lie at different levels with relation to the water table, and are subject to different conditions of drainage. These differences with relation to water create differences in the habitat which are reflected in the vegetation, and in the succession from one association to another.

The Grasse River Bog lies below the level of the water table, and is undrained on account of a barrier esker. The lack of drainage permits the dominance of sphagnum, which in turn "determines the whole subsequent course of vegetation" (page 37). Bray points out that bog conditions are related to two other causes as well as to the lack of drainage. These are low temperature, bogs generally occurring in depressions subject to frost; and the substratum. A substratum of non-calcareous sand favors, or rather does not hinder, the development of acid conditions, whereas a marl or limestone formation is lacking in most of the peat bogs of the Adirondacks. Bray's observations have led him to the conclusion that the dominance of marsh and swamp plants in certain situations, and of bog plants in topographically similar situations, are to be accounted for on the basis of factors now operative, rather than as a phenomena of post-glacial plant distribution. This might be taken to mean that the bog plants are not necessarily relics left over from the post-glacial northward migration, but it might also mean that the physical factors in bogs are such as to permit the continued existence of northern plants which on more favorable habitats have been crowded out.

Four stages of succession in the bog are recognized: (1) The sphagnum-sedge meadow; (2) the sphagnum-heath shrub association; (3 the black spruce-tamarack association; (4) the pioneer stage of balsam swamp forest. There are all gradations in between. Reproduction is largely vegetative, even with the black spruce. As the depth of the sphagnum increases, the lower branches of the black spruce are practically enveloped by the moist blanket, and develop roots which eventually give rise to independent trees. As the forest floor is built up above the level of the peat there develops a balsam fir swamp with red maple in mixture. This is considered an edaphic climax. Whether or not it will develop further the author does not attempt to say, but mentions the presence of yellow birch seedlings on fallen bogs.

On portions of the sand plain which, though low, are slightly above the level of the bog and not covered with sphagnum occurs a vigorous stand of black spruce and larch, which grow more rapidly than in the sphagnum. In mixture there is balsam fir and an occasional white pine and aspen.

On portions of the sand plain which are just as low with reference to the water table as the bog, and are subject to flooding, but well

drained, there is no sphagnum or other bog vegetation. Instead there occurs a grassy meadow (*Calamagrostis canandensis*) which is invaded and later dominated by alder, which probably gives way to a balsam fir swamp.

The higher lying sand plains common in other parts of the State are distinctly dry, as contrasted with those above described. Pitch pine is dominant, apparently in some places following the destruction of the original white pine. On still other sand plains, without sphagnum, black spruce and larch are coming in. The author considers that the difference between the wet and the dry plains is reduced to the occurrence of sphagnum on the former and not on the latter.

This, and similar studies, have a direct value in determining methods of silviculture, in that they show the direction in which the forest is naturally tending, and the influence of the soil factors not only on the present stand but on its future composition. They show the natural limitations which must be borne in mind.

The avoidance of a highly complex terminology or intricate arrangement of the various stages of succession, may detract from the appearance of erudition, but renders the work intelligible to a wider circle of readers. B. M.

University of Washington Forest Club Quarterly. Vol. I. No. 2, 9 illus., 46 pp.; Vol. I, No. 3, 4 illus., 32 pp.

The measure of success achieved by an academic organization which endeavors to publish a quarterly magazine can be judged correctly, only in retrospect. However, the reviewer is prompted to suggest that to have changed from the issue of No. 1 with its nine articles and alumni notes, through No. 2 with four articles, to No. 3 with two articles, is a retrogression. Perhaps the standard of No. 1 was found difficult to maintain. The editors think (No. 3) the quarterly "seems an assured success." The aggressiveness of the advertising manager justifies the statement; the apparent "let up" in the editorial department would seem to contradict the statement. The articles are well worth reading. Future issues will be anticipated with interest.

D. S. J.

A Sawfly Injurious to Young Pines. By W. Middleton. U. S. D. A. Farmers' Bul. 1259, January, 1922.

The larva of Leconte's sawfly is a serious enemy of jack pine, red pine, and scrub pine in nurseries, parks, and reforesting areas in the eastern United States, showing a decided preference for young trees. These are often defoliated and killed or stunted.

Secondary enemies often follow defoliation. The young larvæ are pale white with brownish head, after passing through several molts they become yellowish-white with a number of rows of black spots on the body, and with the head dark brown to orange. When full grown the larvæ spin tough, papery, reddish-brown cocoons. These are often formed several inches underground. The adults are robust dark colored, four winged flies. Eggs are laid in splits made in the needles. Adult emergence is divided into two broods. Control measures are so far restricted to spraying or hand picking in nurseries and parks.

H. B. P.

The Douglas Fir Chermes (Chermes cooleyi). By Chrystal and Story. Bul. 4, Forestry Comm., London, 1922.

The bulletin embodies the results of an investigation into the life history of *Chermes cooleyi,* an American species of the family Chermesidæ, which has made its appearance upon the Douglas fir in England. The paper contains a detailed account of the history of the insect, its life cycle and methods of control. Keys to the genera and species are included.

Results show that many species of Chermes are particularly injurious in plantations where the soil conditions are unfavorable to the species planted. Lack of drainage is often closely allied with infestations.

H. B. P.

Experiments with Spray Solutions for Preventing Insect Injury to Green Logs. By F. C. Craighead. U. S. D. A. Bul. 1079, August, 1922.

For several years there has been an increasing demand for a practical spray that will prevent insect attack to crude forest products such as green saw logs, and timbers used in rustic construction. Often millions of feet of saw timber are blown over by storms and it is impossible to salvage these trees before the wood-boring larvæ get in their work.

Owing to the many different insects, their different methods of attacking the logs, the many kinds of wood to be protected, and the exposure to weather conditions, the practical solution of this problem presents many difficulties.

A spray that would be effective against the different types of insects attacking green logs must be one of disagreeable odor acting as a repellant. It must not be leached off by rain or other weather conditions. It must be inexpensive. It must prevent all insect damage for from one to three months at least. A total of forty-five different sprays were used. Creosote oil proved to be the most effective and may be diluted with as high as 80 per cent of kerosene without diminishing its effectiveness. The paper is of a preliminary nature setting forth the results of experiments carried on so far, and gives promise of successful results if the experiments can be carried on further. H. B. P.

Forest Club Quarterly. University of Washington. Volume X, 1922. Pp. 88.

In the college world the publications are legion. To present a publication at once attractive to the collegian and to the man engrossed in business is indeed a task.

In that regard the Forest Club of the University of Washington has set a real standard. From the field to which the annual is dedicated, the timber resources of the State of Washington, a ready support is merited. The editors have kept well to their thesis in presenting the articles by Zon, Watson, Hofmann, and Pratt, dealing intimately with Pacific Coast problems. "Rest for the Restless," by Pratt (U. S. F. S.), is a bit of interesting anthology. Perhaps a news item from each student would have added sufficiently to the value of the "roster" to warrant the expansion of the volume. The absence of all "jokes" is to be commended. D. S. J.

PERIODICAL LITERATURE

SILVICULTURE, PROTECTION, AND EXTENSION

Blister Rust Control and Forest Succession

Cooper has attacked the problem of blister rust control from the point of view of the ecologist, and determined the abundance of gooseberries and currants in the different stages of forest succession in New England and the Adirondacks. "The two phases of deciduous forest in the region differ strikingly in relative abundant of Ribes, the northern being characterized by a large number of species and individuals, the southern by a paucity of both." The white pine is more abundant in the northern phase.

An interesting chart (p. 9) shows graphically the relative frequency of each of thirteen different trees in each of six different stages of secondary succession, from orchard and pasture to the climax forest. It was found that the gooseberries in the open pioneer stages produced an area of leaf surface 22 per cent greater than in the closed forest. "We conclude, therefore, that the gooseberries are abundant, large, and healthy in the early stages of succession, fruiting heavily and also heavily infected; that they decrease in number and robustness as the succession advances, and in amount of fruit and infection as well, and that in the mature climax forest they seem near to elimination, those remaining bearing practically no fruit and almost no infection."

The dissemination of Ribes by birds was studied, the data being secured from the Biological Survey. A table is given in which the birds are divided into three classes, those living in the open, those unrestricted, and those living in the forest. For each bird are given the number of analyses showing Ribes seeds, the total analyses, and resulting percentage with Ribes seeds. The catbird heads the list with 3 per cent. There are ten with no Ribes records. The conclusion is that the fruit-eating birds of the open which do not frequent the forest are numerous in species and individuals and "are very effective as planters of Ribes." Seeding of Ribes by birds which frequent both the open and the forest, and by those exclusively of the forest "must be of very slight importance."

The practical applications are that "no plant community may be consistently and safely disregarded in the search for Ribes;" and that "it seems possible to prophesy with reasonable certainty whether a tract, once made free of Ribes, will remain so indefinitely, or will have to be watched carefully from year to year." B. M.

Cooper, William S. *"The Ecological Life History of Certain Species of Ribes and its Application to the Control of the White Pine Blister Rust."* Ecology, Vol. III, No. 1, pp. 7-16, 1922.

Rapid Reproduction and Growth

Shull describes the formation of an island three-quarters of a mile long by an eighth of a mile wide in the Mississippi River within the brief space of six years. The obstruction which started the deposition of the island was a stranded barge. Every year, during the flood stages of the river, the island has increased rapidly in size. The soil is a light colored sandy silt, known as cottonwood soil. When the island was visited by Dr. Shull in 1919 it was covered, except for a cultivated field, by a dense cottonwood forest, the trees of which were 4 to 8 inches in diameter and 30 to 40 feet in height. The immediate natural forestation and remarkable rate of growth, an inch a year in diameter and almost 6 feet in height, indicate the possibilities of this type of island, when not under the plough, for large quantity wood production. B. M.

Shull, Charles A. *"The Formation of a New Island in the Mississippi River."* Ecology, Vol. III, No. 3, pp. 202-206, 1922.

FOREST GEOGRAPHY AND DESCRIPTION

Forest Invasion of a Western Bog

Rigg describes a lodgepole pine forest near Victoria, British Columbia, which has successfully invaded a sphagnum bog. The forest is dense pure lodgepole, 20 to 30 feet tall and 6 to 10 inches in diameter at the base. Between the forest and a deciduous thicket small white firs are fairly abundant, and there are a few small Douglas firs and western hemlocks. The conclusion that the lodgepole has been a successful invader of the sphagnum bog is based on: (1) The dominance of the pines. (2) The abundant survival of Labrador tea (*Ledum groenlandicum*) and the occasional survival of peat bog birch (*Betula glandulosa*) (3) The presence of a layer of dead sphagnum.

(4) The similarity between the deeper layers of the substratum in this area and corresponding layers of bogs in Washington and Oregon where living peat still forms much of the surface. (5) The similarity between this bog and the strip of forest along the edge of the Rithet bog which still has a characteristic bog flora. B. M.

Rigg, George B. *"A Bog Forest."* Ecology, Vol. III, No. 3, pp. 207-213, 1922.

Plants and Animals of Mt. Rainier, Washington

Taylor describes the animal and plant life, including the forests, of Mt. Rainier, Washington. He bases his descriptions on both the *life zone,* with *temperature* as the leading factor, and on the *habitat* determined chiefly by *water relations.* Four life zones are recognized on the mountain, namely, the Transition (small area), Canadian, Hudsonian, and Arctic-Alpine. The habitats are divided into three classes, those characterized by extreme moisture, by moderate moisture, and by deficient moisture or rockiness. The forest dominates the Canadian zone, and extends for 500 feet vertically into the Hudsonian. The tree species listed are common to the west slope of the Cascades.

Timberline is found at an average altitude of only 6,500 feet, in spite of the warm, humid climate of the region. Trees extend to higher elevations on the ridges than in the draws. This, and the comparatively low elevation of the timberline, the author attributes to the excessive snowfall which subjects timberline trees "to a stress and strain of the severest character." His photographs (fig. 1, p. 228) corroborate his statements. Taken in connection with the Ecological Society's study of Mt. Marcy, New York,[1] Taylor's conclusion shows that different sets of factors may fix the upper limit of tree growth in different regions. An extremely interesting part of the article is the discussion of distributional problems, and accompanying figures showing the direction of invasion of the different animals, and their spread around the mountain. B. M.

Taylor, Walter P. *"A Distributional and Ecological Study of Mt. Rainier, Washington."* Ecology, Vol. III, No. 3, pp. 214-236, 1922.

[1] Adams, Charles C., Burns, G. P., Hankinson, T. S., Moore, B., and Taylor, N. *"Plants and Animals of Mt. Marcy, New York."* Ecology, Vol. I, Nos. 2, 3, 4, 1920.

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Compiled by Helen E. Stockbridge, Librarian, U. S. Forest Service.

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NOTES

Memorial Tablet to Dr. Rothrock

In the October issue, the Journal of Forestry published a notice of the movement looking to the placing of a bronze memorial tablet in the Department of Forestry in the Pennsylvania State Capitol Building at Harrisburg, commemorating the services of Dr. Joseph Trimble Rothrock, who so faithfully and efficiently served and promoted the forestry interests of our country throughout his lifetime. The project

TO

JOSEPH TRIMBLE ROTHROCK

Born April 9, 1839, died June 2, 1922

Patriot, Soldier, Pioneer, Forester, Botanist, Sportsman, Physician, Educator, Author, Public Servant, Distinguished Citizen, Loving Husband and Father

The Father of Forestry in Pennsylvania

First Commissioner of Forestry of Pennsylvania

Active and Devoted Member of the Pennsylvania State Forest Commission from 1893 until His Death

M. D., University of Pennsylvania, 1867

Professor of Botany at Pennsylvania State College and later at the University of Pennsylvania

A Leader in the Conservation of our Forests and Streams

One of the Founders and a Life-long Member and Officer of the Pennsylvania Forestry Association

Vice President of the American Forestry Association

Honorary Member of the Society of American Foresters

Founder and Promoter of the State Forest Academy and of the Mont Alto Sanatorium

In his life, he exemplified the typical traits and virtues of American manhood, and in his death he left us the memory and example of one who embodied in his character and life, "Whatsoever things are true, whatsoever things are honest, whatsoever things are just, whatsoever things are pure, whatsoever things are lovely, whatsoever things are of good report."

From His Friends.

is in the hands of a committee composed of representatives of the State Forestry Department of Pennsylvania.

Friends and admirers of Dr. Rothrock, who desire to aid in the erection of this memorial, which it is estimated will cost $1,500, should mail their contributions to Dr. H. S. Drinker, Chairman of Committee, Merion, Montgomery County, Pennsylvania. On page 911 is the proposed tablet inscription, which is to be headed by a medallion portrait of Dr. Rothrock to be modelled by the eminent sculptor, Dr. Robert Tait McKenzie, of the University of Pennsylvania:

A Sad Announcement

The California district has suffered a tremendous loss in the sudden death of Sedman W. Wynne, District Forest Inspector, in Los Angeles on October 28. The funeral took place on October 31 and interment was in Oakland.

Mr. Wynne was born at Butte, Montana, on May 24, 1883. He attended school in Montana and later spent three years in the University of California, then going to Yale University, where in 1910 he received a Master's Degree in Forestry. He entered the Service as a forest assistant on July 1, 1910, and advanced steadily, serving later as supervisor of the Cleveland and Sequoia Forests. He was in the Army from January 29, 1918, to February 1, 1919, as Lieutenant in the Air Service. On returning to the district he was given charge of the improvement and minor road and trail work and continued to handle this until his death.

Mr. Wynne was one of the best informed men in the district on engineering work and he had a very keen mind. He has left a strong imprint on the development of suitable standards and practices in the minor road and trail work.

Forestry Conference at Seattle

As planned at the Washington State Forestry Conference held in the autumn of 1921, another forestry conference convened October 11 and 12, 1922, in Seattle. At this conference committees designated to study all phases of the State's forestry problem, with a view to development of an adequate policy, reported. These reports were carefully collated by a representative resolutions committee into a comprehensive State

program which received the unanimous support of the conference. The chief items of change recommended have to do with changes in the administrative machinery handling forest interests, broadening of the policy of acquiring lands for State forests, further improvement in the forest fire laws, and improvement in the methods of assessment and taxation of forest lands. The most important preliminary step in taxation matters which appears quite certain of adoption is the classification of lands for taxation purposes which will give not only a much better basis for taxation but furnish long needed information as to the definite areas of agricultural, forest and other land in the State. The forthcoming issue of the Forest Club Quarterly, University of Washington, will contain the full proceedings of the Conference.

International Forestry Society

In January of 1921, the foreign students of the College of Forestry, University of Washington, Seattle, founded the International Forestry Society with the purpose of keeping in touch with each other after their return to their respective countries, interchanging current developments in the art and science of forestry, and encouraging good fellowship among the foresters of different countries.

The charter members of the organization are Messrs. J. H. Mitchell, England; Helge Sylven and Thoreten Streyffort, Sweden; G. C. Allen, Canada; Florencio Tamesis and Nazario Penas, the Philippines; Horacio Recart, Jr., Chile; and Ralph Dretizler, United States.

Recent additions to the membership of the society include foresters from Australia and Siberia. Steps are under way toward the organization of chapters in Sweden, Canada, the Philippines, India, and the eastern part of the United States. The permanent headquarters of the organization will be located at the University of Washington.

One of the purposes of the organization is to help visiting foresters while in sojourn in those countries where a chapter has been established. The present head of the society is Dean Hugo Winkenwerder, of the College of Forestry, and the officers for the Washington Chapter are Messrs. Horacio Recart, Jr. (Chile), and Robert E. Worthington and Robert Conklin (United States).

SOCIETY AFFAIRS

Comments on Proposed Constitutional Amendments

By Donald Bruce:

In analyzing the criticisms of the proposed amendments printed in the October issue, I was surprised to find the opinion expressed in several instances that today there are no unreasonable or undesirable delays in acting on membership matters. There may be some difference of opinion as to what constitutes an unreasonable period, but I cannot help feeling that some of our members do not realize just how slowly our existing machinery functions. The records of the California Section show that action on the last list nominated before the Section in January, 1922, has not yet been reported. The previous list was nominated in December, 1920, and elected in March, 1922. Apparently a year is about a minimum under the existing procedure.[1] Of this some six months is required for action by the Executive Council after publication of the printed list and an average delay of three months must be added to this on account of the biennial publication of the lists. At least a nine months' saving can therefore be made.

The amendment was not intended as a criticism of the work of our Executive Council. It includes some of the most active and hard-working foresters in our membership and it is undoubtedly a real sacrifice on their part to carry on the work even with the present degree of expedition. To criticise would be ungrateful. What we should do is to so modify our procedure as to make prompt action practicable.

It is easy to over-emphasize the dangers of varying standards of membership. It must be remembered, first, that responsibility breeds conservatism, and that the individual Sections would be the first and principal sufferers were they to relax their standards. A low quality of membership would seriously discredit the reputation of the Section locally, but since the Member and Associate Member have no vote it

[1] The American Society of Naturalists requires that nominations for membership be in the hands of the executive committee *at least a year* before being acted upon. W. N.S.

would not affect the policies of the Society at large. It is my personal belief that no serious or appreciable diversity would result from the substitution of a vote based "on personal acquaintance" (which one critic deplores!), for the present decision based on the perusal of an unsatisfactory and inevitably brief biographical statement. At present the eloquence of a candidate's sponsors is almost as important as his personal qualifications.

There is a general protest on the part of the critics against the statement that control now tends to remain in the Washington Section. It is, of course, true that this Section has today but three representatives on the Executive Council. A fourth member thereof, however, resided in Washington at the time of his election, so that even the present degree of decentralization is more or less fortuitous. Control, however, does not require a majority, but is equally effective through a concentrated minority of a scattered council.

It is of interest in this connection to note that of the thirteen Sections only three have representation on the Executive Council and that eight out of its nine members reside in States bordering on the Atlantic Ocean.

It is argued that the proposed plan would result in an unwieldy Council. With the Sections in existence, its membership would be raised from nine to fourteen, but it is not true that there is no check on further increases, for new Sections can only be formed with the approval of the Council and the country is by now quite thoroughly sectionized. If some years hence, it is found that an unexpected growth of new Sections has caused an unwieldy number of Council members, a reduction thereof by the grouping of Sections into "regions" (along the lines suggested in one of the comments already published), would be relatively simple.

The American Society of Civil Engineers[2] has recently found it necessary to reorganize to secure better geographical representation. In their case I am informed that a very considerable amount of unpleasant friction had developed before the change was made. This friction has not arisen in our Society. The proposed amendments were not presented as a protest to the Washington Section in particular, or to the east in general, for to both the profession of forestry owes a debt of gratitude for the leadership they have taken in Society

[2] The *World Almanac* for 1922 gives the membership of the American Society of Civil Engineers as 10,091. The Society of American Foresters has only about 430 voting members, and less than 900 of all grades. W. N. S.

matters. But in the present situation lies a danger of future discord which the proposed amendment would abate.

By Swift Berry:

It is felt the members of a Section are in the best position to judge of the qualifications of candidates for Member and Associate Member. The placing of responsibility on the Section should insure care by it in considering proposals and the use of letter ballot should eliminate any personal element. The consideration of proposals for Senior Membership where achievement is involved should very properly remain with the Executive Council. For these reasons I am in favor of the first proposed amendment.

Because of its great size the United States includes several general regions of varying conditions, interests and desires. These differences are more likely to increase in the future. Therefore the principle involved in the second proposed amendment seems to me desirable. However, it is realized that the number of Sections will constantly increase and the Executive Council become unwieldy through numbers; then there is some advantage in having the Council elected by a general vote of the Society. In my opinion the desired results might be obtained by an amendment directing that nominations be so made that the Executive Council will consist of the President and Secretary and two representatives of each of five forest regions as follows: 1, New England and Middle Atlantic States; 2, Southern States; 3, Lake and Central States (Eastern Canada); 4, Rocky Mountain and Plains States, and 5, Pacific Coast.

A CORRECTION

The last list of members of the Society gave an out-of-date address for P. H. Clutterbuck (Honorary Member). Mr. Clutterbuck is now Inspector General of Forests to the Government of India, and is located at Simla, India.

MEMBERSHIP

The following Senior Members have resigned from the Society, effective January 1, 1923:

E. R. Hodson
Dana Parkinson
J. B. Saxton
O. F. Schaefer

Wilfred W. White has been elected to Senior Membership, effective November 26, 1921.

D. D. Wood, elected Senior Member in March, 1922, has declined election.

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INDEX

art. = article; rev. = review; ref. = reference (current literature); br. = brief (periodical literature); e. c. = editorial comment; n. = note.

Adirondacks, fire hazard, art..... 629
forest development, rev..... 895
hardwood type, studies, art..... 571
mountain club, n..... 563
Aerial forest work, British Columbia, n..... 566
Canada, n..... 566
Ontario, n..... 564
Aeroplanes, use in forest surveys, art..... 113
for forest work, ref..... 304
Afforestation, India, rev..... 146
Alaska, development of pulpwood resources, rev..... 145
interior forests, art..... 363
ALLISON, J. H., art..... 538
Alsace-Lorraine, deforestation, br. 412
forest organization, br..... 154
"American forest regulation," rev.. 545
American forestry ass'n, new forester, n..... 168
pulp and paper ass'n, woodlands sec., officers, n..... 564
Scandivarian foundation, "students' tour," n..... 566
trees in Scotland, art..... 71
"Ames Forester," 1922, rev..... 892
ANDERSON, C. R., art..... 264
Angio—and gymnosperm wood differentiated by Mäule reaction, art..... 476
Annual cut, determination, art. 611, 626
rings, use in climatic study, rev. 888
Appalachian experiment station, n. 432
ASHE, W. W., art..... 276
Australia, articles on forestry, ref. 308

BAKER, F. S., and KORSTIAN, C. F., art..... 755
Balsam, growth, Adirondacks, art. 598, 603
Beaver, work of, n..... 829
Beech in Germany, br..... 293
Belgium, increased forest values, br..... 415
BELYEA, H. C., art..... 603
Bibliographies, ref. 662
BISHOP, L. L., art..... 765
Black jack oak, new variety, n..... 167
Blister rust control and forest succession, br. 900
Botanical abstracts, n..... 685
BOWMAN, B., art..... 3
Brazil, forestry, art..... 872
British Columbia, aerial forest work, n. 566
forestry problems, art..... 44
timber supplies, art..... 699
Empire forestry conferences, ref. 903
forests, subsidy, br..... 300
BROWN, N. C., art..... 135
honored, n. 684
Brush disposal, *see* Slash disposal
BUTLER, O. M., forester to American forestry ass'n, n..... 168
BUTTRICK, P. L., art..... 527

California, management in redwood region, art. 396
trees, rev. 633
Canada, aerial patrol work, n..... 566
federal research work, art..... 62
forest situation, art., 1, 3, 4, 10, 18, 25, 44, 54, 62, 67
historical sketch of timber industry, ref. 662
timberland administration, art.. 4
Western, status of forestry, art. 10
Canadian pulp and paper ass'n, woodlands sec., mtg., n..... 564
CARY, AUSTIN, art..... 788
Catalpa and locust, n..... 318
CAVERHILL, P. Z., art.....44, 699
Cedar exported to Japan, rev..... 803
CHAPMAN, H. H., art.....581, 729
China, progress of forestry in, 1919-20, ref. 303
Climate, evolution of, br..... 810
Climatic study and use of annual rings, rev. 888
Colorado, streamflow experiment, br. 811
Commerce reports, ref., 305, 556, 670, 820, 905
Coniferous resources of world, br. 415
Conifers, preferences for acid soils, art. 488
Conservation of natural resources, ref. 423, 818, 905
Construction materials, wood, br.. 301
Consular reports, ref..... 425
Cost factors in growing timber, art. 589

Costs, logs from small and large timber, rev. 805
regeneration fellings, br..... 409
Cutting, complete vs. partial, n.... 561
methods in Norway pine, art.... 851
Cypress, growth, br..... 299

Damtoft, W. J., art..... 228
Dana, S. T., art..... 223
DeSmidt, W. J., art..... 352
Dominican republic, forests, br.... 809
Douglas fir *Chermes*, rev..... 898
replacing western yellow pine? art. 755
DuMond, F. L., art..... 448
Dunning, D., art..... 379
Dwight, T. W., art..... 4

Education, *see* also Forest schools.
forestry extension work, art.... 264
report of committee on..... 189
Empire state forest products ass'n, 1921 meeting, rev..... 78
England, timber exhibits, br..... 421
Eucalyptus, revision, ref..... 903
the tall, n..... 320
European forestry, impressions, rev. 649
Evaporation and forest fires, br.. 292
Even-aged stands, n..... 832
Exotics at Barres, br..... 411
Mont Alto, Pa., art..... 735

Farmer and forestry extension work, art. 264
Faull, J. H., art..... 67
Fenska, R. R., art..... 593
Fernow, B. E., art..... 1
recognition, n. 683
Financial rotations, br..... 299
Fires *see* also Forest fires and Forest protection.
lessons from, ref. 697
spray systems for pulpwood piles, br. 157
Forest administration, ref., 303, 554, 665, 904
articles on, ref..... 423
extinction of rights of user, br. 155
botany, ref. 663, 817
articles, ref. 552
by-products, ref. 423, 666, 818
dendrology, articles, ref. 552
haldu, br. 160
odina Wodier, br..... 162
Quercus marilandica ashei, n. 167
semal or cottonwood, br..... 162
trees of Indiana, rev..... 399
denudation, example, br..... 84
ecology, ref. 905
birch succession in sphagnum bogs, art. 848
blister rust control and forest succession, br. 900
branch orders and tolerance, art. 448
development on sand plain, rev. 895
forest invasion of sphagnum bog, br. 901
nitrogen and reproduction, art. 497
and vegetation, br..... 404
peat and transpiration, br.... 404
regeneration of sal, br..... 408
soil acidity preferences of conifers, art. 488
soil type and root form, rev... 147
economics in Norrland, br..... 420
statistics, ref. 303
education, articles on, ref..... 422
course in log scaling, rev..... 801
engineering, ref. 904
entomology, Douglas fir *Chermes*, rev. 898
insects, ref. 423, 553
June beetle, br..... 410
mound-building ants, art..... 325
sawfly, rev. 898
white pine weevil, rev..... 895
environment, research in, rev... 634
experiment stations, congressional bills for, n..... 90
two new, n..... 432
finance, future value, br..... 413
increased values, Belgium, br. 415
interest, br. 415
fires, *see also* Forest protection.
an effective organization, art.. 499
and evaporation, br..... 292
hazard, Adirondacks, art..... 629
manual, ref. 423
origin, br. 298
protection, cooperation in Georgia, n. 166
and seasonal distribution of rainfall, art. 776
weather records from lookouts, art. 215
journals, articles in, ref.....426, 559
lands, purchase, ref..... 554
legislation, ref. 554, 665, 818
taxation, Maine, n..... 826
Sweden, n. 313
management, *see* also Forest organization.
ref. 817
complete vs. partial utilization, n. 561
controls white pine weevil, rev. 895

development of French methods, art. 883
"expectation value" theories, br. 290
Harvard forest, rev. 75
to keep pine lands productive, art. 533
suggestion for basis, art..... 854
maps, India, ref..... 304
mensuration, *see also,* Growth, Volume, Yield.
rev. 139
age charts and yield studies, art. 390
data on Sal stumps, br..... 155
forest control book, br..... 89
HOYERS' formulæ, rev..... 640
measuring heights on sample plots, art. 220
problems, rev. 646
on sample plots, art..... 220
volume tables for pines in Minnesota, art. 714
redwood, rev. 149
white fir, rev..... 75
organization, Alsace-Lorraine, br. 154
better woodlot management, art. 261
crowns and growth rate, art... 379
determining cut, art.....611, 626
development of, br..... 410
public on private lands, art... 130
public forestry on private lands, a correction, n..... 562
redwood region, art..... 396
response to cutting, art..... 379
pathology, ref. 664
control of white pine weevil, rev. 895
costly timber, n..... 321
mycorhizas of conifers, art... 255
problems in Ontario, art..... 67
plantations, Lake Vadnais, St. Paul, Minn., art..... 538
mound-building ants in, art.... 325
in Punjab, irrigated, br..... 154
spacing conifers, br..... 291
planting, seedling vs. transplanted stock, art. 393
tool, new, br..... 153
policy, ref. 818, 904
on American, br..... 160
national, art. 788
timberland administration, Canada, art. 4
products laboratory, ref..... 554
decennial record, 1910-20, ref.... 422
protection, *see also* Forest fires.
br. 298
animals, ref. 664, 817
diseases, ref. 664
fire, ref.....303, 664, 817, 904
report, committee on forest fire matters 183
articles on, ref..... 553
insects, ref. 664, 817
Michigan forests damaged by storms, art. 527
mound-building ants, art..... 325
slash disposal and entomology, art. 437
week, second annual, n..... 564
regulation, American, rev..... 545
reproduction and bear clover, art. 745
research, reproducing hardwood stands, art. 869
reproduction and humus and root systems, art. 233
errata, opp..... 570
results in treating white pine stands, rev. 284
sample plots, art..... 220
significance of ray volumes, art. 337
southern pines experiments, art. 780
study of environment, ref..... 663
studies in reproduction, art... 571
types as guide for silviculture, art. 276
resources of Far Eastern Republic, ref. 552
Poland, ref. 663
of world, br. 415
of Salsmann pine, br..... 289
schools, ref. 522
California, ref. 522
France, br. 159
graduates, index of forestry progress, art. 876
India, ref. 422
Michigan, ref. 816
Minnesota, ref. 522
North Dakota, ref..... 816
Penn State Academy, ref..... 663
Yale, ref. 422
species, silvical studies of, ref., 663, 817, 904
statistics, ref. 303, 818
stories and legends, ref..... 667
succession and blister rust control, br. 900
supplies, British Columbia, art.. 699
Wisconsin, rev. 398
surveys, use of aeroplanes for, art. 113
taxation, Sweden, n..... 313
trees, exotics at Mont Alto, Pa., art. 735

large transplanting, n..... 828
seed studies, n..... 316
types, guide for developing silviculture, art..... 276
New England, art.....122, 233
and regions, basis for management, art..... 854
and soil, br..... 403
studies, br..... 151
utilization, articles on, ref., 423, 554, 665
basswood, ref..... 818
and forestry, art..... 465
lavender, br..... 160
lumber industry, ref..... 304
place in American forestry, art..... 135
relative costs of logs, rev..... 805
resin and turpentine industry, India, rev..... 400
value of pinon, art..... 521
wood-using industries, ref., 304, 423, 554, 666, 818, 905
what is a, art..... 209
Forestry, articles on, ref., 304, 423, 555, 667, 819, 905
clubs, intercollegiate ass'n, mtg. at Syracuse, n..... 563
conference at Seattle, n..... 912
guide to, ref..... 816
journals, articles in, ref., 308, 676, 823, 908
national and economic aspects, art..... 93
progress as shown in forest school graduates, art..... 876
recreational, ref..... 554
in United Kingdom, art..... 93
and utilization, art..... 465
for woodsmen, ref..... 662
Forests of Rumania, br. 87, art... 513
of Russell Co., Va., ref..... 552
and stream control, ref..... 696
France, anti-fire commission, br.. 412
development of management methods, art..... 883
exotic trees, br..... 411
national school of forests and waters, br..... 159
oaks of Troncais, br..... 814
reforestation, br..... 414
sales of wood in 1920, br..... 300
timber prices, br..... 158
visited by English foresters, br. 152
French colonial forests, br..... 158
forestry victorious, br..... 161
forests, Cherimont, br..... 150
Plancher-les Mines, br..... 150
Frosts (spring) and growth, br.... 151
Frustum form factor volume tables, art..... 714

GARRATT, G. A., art..... 479
GASKILL, A., retires, n..... 681
Georgia, cooperation in fire protection, n..... 166
resources and opportunities, n... 166
Germany, budget for 1921, br..... 156
forest fire damage, br..... 153
forestry in, since 1914, art..... 770
timber production, br..... 546
Germination, delayed, br..... 407
GIBSON, R. A., to West Australia, n..... 565
GRAHAM, S. A., art..... 437
GRAVES, H. S., Dean at Yale, n... 90
Grazing, ref..... 667
Great Britain, financial statistics, br..... 813
Growth of cypress, br..... 299
on large areas, measurement, art.....581, 586
and spring frosts, br..... 151
spruce and balsam, art.....598, 603
and yield, oak and ash, ref..... 553
"Guide to silviculture," new French conditions, rev..... 157
GUISE, C. H., art..... 589
GUTHRIE, J. D., art.....363, 513

HANSEN, T. S., art..... 714
HANZLIK, E. J., art.....611, c. 626
Harvard forest, management, rev. 75
silviculture, art..... 117
Heath, Lunebürger, br..... 84
Height growth and meteorological conditions, rev..... 890
Hemlock, "weeping," art..... 272
Hickory borer, ref..... 553
Himalayas, forests, br..... 150
HOPKINS, A. S., art..... 629
Humus and root systems and reproduction, art..... 233
errata, opp..... 570
Hypsometer, home-made, br..... 156

Illinois forestry ass'n, n..... 564
Increment, spruce and balsam fir, art.....598, 603
India, afforestation, rev..... 146
forests of, ref..... 663
irrigated plantations, br..... 154
regulation methods, br..... 413
research institute, ref..... 904
resin and turpentine industry, rev. 400
Indiana, trees of, rev..... 399
woodlands and management, ref. 817

Insect injury prevented by spray solutions, rev. 898
Intercollegiate ass'n of forestry clubs, mtg. at Syracuse, n..... 563
International forestry society, n... 913
Intolerance, factor in maintenance of type, art..... 463

Jean de la Fontaine, tricentenary, br. 162
Journal of Forestry, prices of reprints, n. 685

Korstian, C. F., and Baker, F. S., art. 755
Krauch, H., art.....220, 390, 463

Laborador, forests, br..... 809
Land classification basis for taxation, n. 913
southern states, n..... 166
Lane-Poole, C. E., to New Guianea, n. 565
Larsen, J. A., art..... 215
Lavender, br. 160
Legislation, *see* Forest legislation.
Loblolly pine × longleaf, art..... 729
Locust and catalpa, n..... 318
Log scaling, trade course, rev., 801, 904
London trees, ref..... 903
Longleaf pine × loblolly, art..... 729
"Lumber," rev. 799
industry, ref.....665, 818, 905
articles, ref..... 554
journals, articles in, ref., 305, 425, 556, 820, 905
Lumberman sets value on young growth, e. c..... 428

Mahogany, true, identification, ref. 554
Maine forestry ass'n, resolutions, n. 164
Management of forests, French, rev. 144, 286
Maple, silver, investigation of seed, ref. 552
Maritime pine, new tapping methods, br. 301
Mason, D. T., art..... 396
Massachusetts forestry ass'n, excursions, n. 564
Mäule reaction for wood of angio- and gymnosperms, art..... 476
McDougall, W. B., art..... 255
Melolontha vulgaris, F., br..... 410
Mensuration, *see* Forest mensuration.
Meteorological conditions and height growth, rev..... 890
Meteorology and reforestation, br. 296
Michigan, forests and dunes, ref. 816
Millar, W. N., art..... 10
"Minimum requirements"—private owner's standpoint, art..... 228
regulations of cut, art..... 223
Miscellaneous, killing worthless species, br. 159
Mistletoe, eradication, art..... 627
Mixed stands, br. 550
soil a factor, br.....83, 550
Monterey pine, remarkable growth in Australia, n..... 682
Moore, Barrington, art..... 233
Morbeck, G. C., art..... 533
Mount Ranier, flora and fauna, br. 902
Munns, E. N., art.....497, 745
Myer, J. E., art..... 337

National conference on state parks, second, n. 565
forest policy, art..... 788
forestry in Pennsylvania, art... 765
Naval stores, France, br..... 301
Nebraska forestry ass'n, n..... 565
Newins, H. S., art..... 272
New Brunswick, forestry administration, art. 54
New England forestry congress, Boston, n. 826
regional classification, art..... 122
and type classifications, art., 122, 233
revision of type classification, art. 795
New Jersey, A. Gaskill retires, n. 681
New South Wales, forestry statistics, br. 812
New York, conservation commission, E. J. Staley resigned, n. 565
Hon. Alex. Macdonald appointed, n. 565
New Zealand, forestry report, br.. 813
Nitrogen and vegetation, br..... 404
North Carolina, forestry ass'n, resolutions, n. 163
Norway pine, cutting methods, art. 851
Nursery practice, ref. 422, 553, 664, 817
for reforesting rocky lands, n.. 310

Oak and ash, growth and yield, ref. 553
Obituary, Dr. J. T. Rothrock.... 567
Wynne, S. W..... 912
Olmstead, F. E, art..... 106
Ontario, aerial reconnaissance work, n. 565
forest pathology problems, art... 67
reforestation, art. 18

Organization, *see* Forest organization.

Paper and pulp, *see* Pulp and paper.
Parks, Canada, ref.... 666
national, ref. 819
Iowa, ref. 304
Wisconsin, ref. 666
Pathology, *see* Forest pathology.
PAUL, B. H., art.... 393
PEARSON, G. A., art.... 776
PEIRSON, H. B., art.... 325
Pennsylvania, forestry commissioner, GIFFORD PINCHOT resigned, n. 566
R. Y. STUART appointed, n.... 566
national forestry in, art.... 765
planting problems, art.... 507
PERRY, G. S., art....507, 735
PERRY, W. J., art....521, 627
PICHE, G. C., art.... 25
Pine, lands, to keep productive, art. 533
Monterey, remarkable growth in Australia, n. 682
a new hybrid, art.... 729
Norway spruce forests, br.... 83
remarkable growth in Australia, n. 431, 682
Salzmann, forest of, br.... 289
sawfly injurious to young, rev... 898
southern, sample plot experiments, art. 780
western yellow, even-aged stands, n. 832
Piñon, value of, art.... 521
Pinus insignis, remarkable growth in Australia, n.... 431
Plantations, *see* Forest plantations.
Planting, *see also* Forest planting.
Planting, ref.....422, 553, 664, 817
problems in Pennsylvania, art.... 507
Poisonous woods, art.... 479
Poland, forest resources, ref.... 663
Policy, *see* Forest policy.
Portugal, forest conditions, br.... 810
Preservatives, kill worthless species, br. 159
timber preserved in U. S., n.... 562
Prices, timber in France, br.... 158
wood in France, br.... 300
PRINCE, G. H., art.... 54
Private forests, publicly managed, art. 130
a correction, n.... 562
Professional ethics, art.... 106
further comments, n.... 561
Protection, *see also* Forest protection.
spray solution for insect injury, rev. 898
Prussia, forest control book, br... 89
Prussian Solling, forest information from, br.... 85
state forests, br.... 159
"Public forestry on private lands," art. 130
a correction, n.... 562
Pulpwood piles, spray systems for, br. 157
resources of Alaska, rev.... 145

Quebec, the forests, art.... 25
Quercus marilandica, new variety, n. 167

Rainfall, seasonal distribution and forest fires, art.... 776
Ray volumes, significance, art.... 337
Rays in slippery elm, art.... 352
RECKNAGEL, A. B., art.....374, 598
Reclamation of land, ref.... 304
Red pine, natural reproduction, n.. 828
Redwoods, half million for saving, n. 433
region, forest management in, art. 396
Reforestation, France, br.... 414
and meteorology, br.... 296
Ontario, art. 18
Regeneration, fellings, cost, br.... 409
of sal forests, br.... 408
Reports, forestry, New Zealand, br. 813
and proceedings of associations, etc., ref.....303, 422, 552, 816, 903
Reproduction, and growth, rapid, br. 901
natural, from single tree, n.... 828
and nitrogen, art.... 497
studies in, art.... 571
Research, *see also* Forest research.
in forest environment, rev.... 634

REVIEWS:

Ames Forester, 1922.... 892
BATES, C. G., and ZON, R., research on forest environment.... 634
BENSKIN, E., India, afforestation.. 146
BIOLLEY, H. E., management of forests 144
BRAY, W. L., forest development on an undrained sand plain.. 895
BRUCE, D., cost of logs from small and large lumber.... 805
white fir volume table.... 75

REVIEWS—Continued
Bryant, R. C., lumber..... 799
Chapman, H. H., forest mensuration 139
Chrystal and Story, Douglas fir *Chermes* 898
Clark, D. H., Western red cedar to Japan 803
Clark, E. T., and Winkenwerder, H., mensuration handbook.... 646
Craighead, F. C., spray solutions, prevention for insect injury.. 898
Cunliffe, N., and Hiley, W. E., height growth and meteorological conditions 890
Deam, C. C., trees of Indiana.... 399
Douglass, A. E., use of annual rings in climatic study..... 888
Empire St. for. prod. ass'n, papers at mtg., 1921..... 78
Fisher, R. T., Harvard forest management 75
Frazier, A. J., India, resin and turpentine industry..... 400
French forest, management..... 286
Haasis, F. W., soil type and root form 147
Hawley, R. C., white pine stands, treating 284
Hiley, W. E. and Cunliffe, N., growth and meteorological conditions 890
Hosmer, R. S., impressions of European forestry 649
Howard, S. H., statistical data, collecting, etc. 650, 807
Idaho, course in log scaling..... 801
Middleton, W., sawfly injurious to pines 898
Peirson, H. B., control of white pine weevil 895
Pratt, M. B., trees of California.. 633
Redwood, volume tables..... 149
Smith, C. G., pulpwood resources of Alaska 145
Soderlund, N. L., on Hoyers' formula for tree form..... 640
Story and Christal, Douglas fir *Chermes* 898
Tillotson, C. R., tree seed storage 642
Washington, Forest Club quarterly, 897, 899
Winkenwerder, H., and Clark, E. T., mensuration handbook. 646
Wisconsin, timber for the state.. 398
Woolsey, T. S. Jr., "American forest regulation" 545
Zon, R., and Bates, C. G., research on forest environment..... 634

Rights of user, extinction of, br.. 155
Roosevelt experiment station, ref. 663
Root form and soil type, rev..... 147
Rothrock, J. T., obituary 567
memorial tablet, n.....684, 911
Rumania, forests, art..... 513
and game, br..... 87

Sample plots, measuring tree heights, art. 220
Sand plain, forest development on, rev. 895
Sargent, C. S., manual, new edition, rev. 303
Sawfly injurious to young pines, rev. 898
Schenck, C. A., art..... 770
Schools, *see* Educational and Forest schools.
Scotch pine, delayed germination, br. 407
Scotland, American trees in, art... 71
Seeds, storage of, rev..... 642
and treatment, n..... 316
Shade trees, New Hampshire, ref. 903
Sharma, P. D., art..... 476
Shelterwood method, reproducing hardwood stands, art..... 869
Show, S. B., art.....470, 606
Sihlwald, Meister's book on, n... 563
Silviculture, against clear cutting, br. 411
the "continuous forest," br., 295, 651-61
conversion into selection forest, br. 297
cutting method, new, br..... 405
methods in Norway pine, art.. 851
for pine release, art..... 117
guide for American, art..... 276
hardwood stands under shelterwood method, art..... 869
nursery practice, ref., 422, 553, 664, 817
permanent canopy forest, br..... 154
planting, ref.....422, 553, 664, 817
in Prussian Solling, br..... 85
regional and type classifications, New England, art.....122, 233
regulation of cut, art..... 223
reproduction of forests, methods, br. 297
selection forest, use of stand graph, art. 374
stand graph, regulating cut, art. 374
strip cuttings, br..... 298
timber production, br..... 546
Silvicultural treatment of Spessart oak, br. 152

Site, quality of and mature timber, art. 470
Slash disposal, entomological aspects, art. 437
Smoking pipes, woods for, br..... 157
Society affairs, annual meeting, Toronto, 1921 .....1, 169
address of welcome..... 3
meeting, 1922, announcement, 686, 834
summer meeting, Salt Lake City 323
membership, elections, resignations, etc., 322, 570, 686, 834, 916
proposed amendments to constitution 687
comments on...689, 835, 914, 916
reports of secretary..... 174
of treasurer 174
of committee on admissions. 177
of committee on forest fire matters 183
of committee on forestry education 189
representative for Standardization of cross-ties..... 569
Standardization methods of testing wood 569
Sections, Denver 696
New England, meeting..323, 696
officers, 1922, different sections 434
changes 834
Pennsylvania, meeting 434
Southern Appalachian, summer meeting 696
Soils, acidity preferences of conifers, art. 488
erosion and streams, ref..... 697
and forest types, br..... 403
the humic acids, br..... 289
type and root form, rev..... 147
Southern experiment station, n... 432
forestry congress, third, n..... 166
states, land classification, n..... 166
Spaeth, J. N., art..... 117
Spessart oak, br..... 152
Sphagnum bog invaded by forest, br. 901
Spray solutions, prevention for insect injury, rev..... 898
Spring, S. N., art..... 571
Spruce, growth, Adirondacks, art., 598, 603
tanbark exploitation, br..... 156
State statistical data, collecting and tabulation, rev.....650, 807
Statistics, Belgian state forests, br. 157
forestry, New South Wales, br.. 812
wood for smoking pipes, br.... 157
Stone, H. A., textbook of wood, ref. 304
Storm damage to Michigan forests, art. 527
Streamflow experiment, Colorado, br. 811
Street trees, ref..... 422
Strip cuttings, br..... 298
"Students' tour," Am. Scand, foundation, n. 566
"Studies in French forestry," review of, br. 161
report errors, n. 566
Stumps, experiments for blasting, br. 162
Subsidies, British forests, br..... 300
Succession, birch in sphagnum bogs, art. 848
Sutherland, J., art..... 71, 93
Sweden, economics, in, br..... 420
forest taxation, n..... 313
Swiss forestry association, br..... 302
national park, br..... 161

Tanbark from spruce, br..... 156
Tariff and taxation, ref..... 665
Taxation, based on land classification, n. 913
Maine, n. 826
Sweden, n. 313
and tariff, ref..... 665
Technology, *see* Wood technology.
Ties and poles, wood for n..... 826
Timber exhibits, England, br..... 421
growing, cost factors, art..... 589
physics, rays in slippery elm, art. 352
significance of ray volumes, art. 337
quantities in British Columbia, art. 699
quantity preserved in U. S., n.. 562
supply, economic aspects of, art. 837
wormy, costly, n..... 321
Tolerance indicated by branch orders, art. 448
Tool, new, for planting, br..... 153
Trade journals, articles in, ref., 305, 425, 556, 670, 820, 905
Transpiration, influence of peat, br. 404
Transplanting large forest trees, n. 828
Tree form formulæ, Hoyers', rev. 640
nursery, n. 310
surgery, ref. 663
Trees, field manual of, ref..... 903
for streets, ref..... 422
Tsuga heterophylla flaccida, art... 272
Turpentine and resin industry in India, rev. 400

Type classification for New England, revision, art..... 795

United Kingdom, forestry, art..... 93
Upson, A. T., art..... 465
Utilization, *see also* Forest utilization.

Venezuela, vegetation maps, br.... 811
Volume tables, method of preparing, ref..... 553
for pines in Minnesota, art.... 714
for sal, ref..... 664
second growth redwood, rev.. 149
white fir, rev..... 75

Washington, University, Forest Club quarterly, rev.....897, 899
Waugh, F. A., art..... 209
Weather records in Idaho, 1919, art. 215
Western red cedar to Japan, rev... 803
yellow pine, crowns and growth rate, art..... 379
even-aged stands, n..... 832
intolerance factor of type, art..... 463
replaced by Douglas fir? art. 755
response to cutting, art..... 379
site and mature timber, art. 470
soil type and root form, rev. 147
Wherry, E. T., art..... 488
White fir volume table, rev..... 75
White pine results in treating, rev. 284
survey in Pennsylvania, n..... 830
weevil, controlled by forest management, rev. 895
yield table, art. 593
Wilson, Ellwood, art..... 113
Wirt, G. H., art..... 499
Wisconsin, timber supplies, rev... 398
Wood, as construction material, br. 301
preservation, ref.....555, 666, 818
technology, ref....304, 554, 666, 818
seasoning of woods, ref..... 423
textbook of, by Stone, ref..... 304
Wooden vessels sold at loss, n.... 826
Woodlots, better management, art.. 261
forestry extension work, for art..... 264
Woods, seasoning, ref..... 423
Woodsmen, contented, br..... 551
Woodward, K. W., art..... 261
Woody plants for decorative gardening, ref..... 816
Woolsey, T. S. Jr., art..... 130
Wright, W. G., art..... 62
Wyman, L., art..... 780
Wynne, S. W., obituary..... 912

Yale, financial resources increase, n..... 168
H. S. Graves, new dean, n..... 90
Yellow pine, determining yield, art. 606
even-aged stands, yield, art... 606
Yield, experiments for increasing, br..... 161
methods of determining, art..... 606
regulation methods, br..... 413
studies and diagram age charts, art..... 390
tables, application, art..... 581
white pine, art..... 593

Zavitz, E. J., art..... 18

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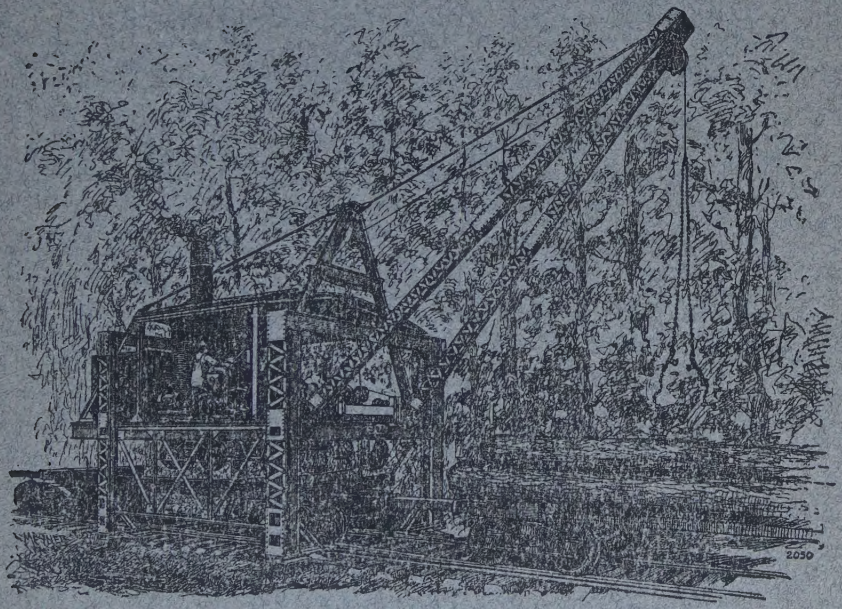

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CONTENTS

PAGE

Economic Aspects of Our Timber Supply 837
W. B. Greeley.

Birch Succession in Sphagnum Bogs 848
George B. Rigg.

Cutting Methods in Norway Pine 851
T. Schantz-Hansen.

A Suggestion for Forest Regions and Forest Types as a Basis of Management in New York State 854
Harold Cahill Belyea.

Results of an Experiment in Reproducing Hardwood Stands under the Shelterwood Method 869
William D. Durland.

Forestry in Brazil 872
Joseph Kircher.

Classification of Forest School Graduates as an Index of the Progress of Forestry 876
E. A. Ziegler.

Development of (French) Management Methods from 1912 to 1922 883
A. Schaeffer.
(Translated by T. S. Woolsey, Jr.)

Reviews 888

Periodical Literature 900

Current Literature 903

Notes 911

Society Affairs 914